MHI
Copy 3

COL. F H MEINERT

FM 44-1

DEPARTMENT OF THE ARMY FIELD MANUAL

MHRC
COPY 1

ANTIAIRCRAFT ARTILLERY EMPLOYMENT

REGRADED UNCLASSIFIED BY
AUTHORITY OF DOD DIR. 5200.1 R
BY RMH-225 ON 8/1/03

DEPARTMENT OF THE ARMY APRIL 1952

AGO 3199C—Apr [redacted]

[redacted]

DEPARTMENT OF THE ARMY FIELD MANUAL
FM 44–1
This manual supersedes FM 4–100, 28 June 1943

ANTIAIRCRAFT ARTILLERY EMPLOYMENT



DEPARTMENT OF THE ARMY *APRIL 1952*

United States Government Printing Office
Washington: 1952

[redacted]

AGO 3199C

[redacted]

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *16 April 1952*

FM 44–1 is published for the information and guidance of all concerned.

[AG 300.7 (22 Dec 51)]

BY ORDER OF THE SECRETARY OF THE ARMY:

OFFICIAL:
WM. E. BERGIN
Major General, USA
The Adjutant General

J. LAWTON COLLINS
Chief of Staff
United States Army

DISTRIBUTION:

Active Army:

Tech Svc (1); Admin & Tech Svc Bd (1); AFF (40); AA Comd (10); OS Maj Comd (5); Base Comd (3); MDW (5); Log Comd (2); A (5); CHQ (3); Div (5); Brig 6 (1), 44 (3); Regt 6 (1), 44 (3); Bn 6 (1), 44 (3); Co 44 (2); USMA (10); Sch (2), except 6, 44 (50); PMS&T (2), except 44 (10); Mil Dist (3).

NG: Same as Active Army.

ORC: Same as Active Army.

For explanation of distribution formula, see SR 310–90–1.

[redacted]

CONTENTS

		Paragraphs	Page
CHAPTER 1.	INTRODUCTION	1–3	1
2.	MISSION	4, 5	2
3.	TACTICAL ORGANIZATION		
Section I.	Classification of antiaircraft artillery.	6–8	3
II.	Major antiaircraft artillery echelons.	9–14	4
CHAPTER 4.	COMMAND		
Section I.	Artillery commanders	15–22	7
II.	Antiaircraft artillery staff	23–27	12
CHAPTER 5.	AIR DEFENSE		
Section I.	Introduction	28–30	17
II.	Priorities for air defense	31, 32	18
III.	Allocation of means	33, 34	19
IV.	Responsibility for determination of priorities and allocation of means.	35–39	20
CHAPTER 6.	ORGANIZATION FOR AIR DEFENSE		
Section I.	Introduction	40, 41	24
II.	Organization for the air defense of the continental United States.	42, 43	24
III.	Organization for air defense in theater of operations.	44–47	31
IV.	Command, control, and coordination in the combat zone.	48–51	33
V.	Tactical air	52–56	37

		Paragraphs	Page
CHAPTER 7.	EMPLOYMENT OF ANTIAIRCRAFT ARTILLERY IN AIR DEFENSE MISSION.	57, 58	41
8.	DESIGN OF MEDIUM AND HEAVY ANTIAIRCRAFT ARTILLERY DEFENSES		
Section I.	Introduction	59–64	45
II.	Tools for defense designs	65–68	48
III.	Simple defense design	69, 70	55
IV.	Major terrain difficulties	71, 72	58
V.	Special considerations	73–79	62
VI.	Fire direction	80–82	79
VII.	Incidental protection	83–85	80
CHAPTER 9.	DESIGN OF LIGHT ANTIAIRCRAFT ARTILLERY DEFENSES		
Section I.	Introduction	86–90	92
II.	Tools for analysis and design of light AAA defenses.	91–94	95
III.	Defense of a vulnerable area	95, 96	101
IV.	Establishing a defense with major terrain difficulties.	97, 98	105
V.	Special considerations	99–105	109
VI.	Fire direction	106–108	113
CHAPTER 10.	ANTIAIRCRAFT OPERATIONS CENTER AND ANTIAIRCRAFT ARTILLERY INFORMATION SERVICE		
Section I.	Introduction	109, 110	116
II.	Antiaircraft operations center (AAOC).	111–120	117
III.	Antiaircraft artillery information service.	121–126	122
CHAPTER 11.	SURFACE MISSION	127–133	130
12.	SPECIAL CONDITIONS OF EMPLOYMENT.	134–136	136

		Paragraphs	Page
CHAPTER 13.	COMMUNICATIONS		
Section I.	Introduction	137–140	138
II.	Wire and radio communications.	141, 142	142
CHAPTER 14.	SUPPLY AND EVACUATION	143–145	144
15.	RECONNAISSANCE, SELECTION, AND OCCUPATION OF POSITION BY HIGHER AA ECHELONS		
Section I.	Introduction	146–149	147
II.	Reconnaissance by higher echelon for air defense mission.	150–152	148
APPENDIX I.	REFERENCES		150
II.	GLOSSARY		152
III.	TABLES		156
INDEX			162

FIELD MANUAL

ANTIAIRCRAFT ARTILLERY EMPLOYMENT

CHANGES No. 1

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *30 June 1954*

FM 44-1, 16 April 1952, is changed as follows:

18. AAA Brigade Commander

Whether the AAA * * * following specific items:

* * * * * * *

e. Establishment of conditions of readiness and **their transmission to the fire units.**

* * * * * * *

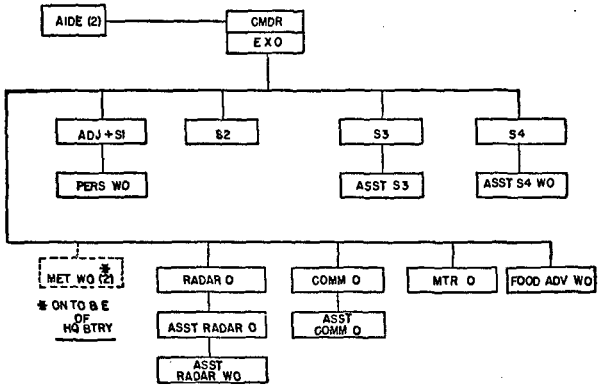


Figure 1. (Superseded.) *A type organization of a brigade staff.*

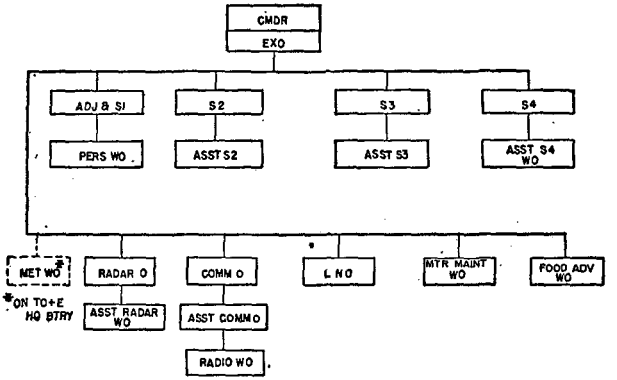


Figure 2. (Superseded.) *A type organization of a group staff.*

49. Antiaircraft Artillery in the Division Area

The division commander will determine the mission (air defense or surface) of the AAA which is assigned or attached to the division. He will establish the **priorities** for the air defense of installations within the division area. **The division artillery commander will allocate available AAA based upon these priorities.** Effective air defense * * * of integrated defenses.

* * * * * * *

CHAPTER 9.1

DEFENSE AGAINST AIRBORNE ATTACK, GUERRILLA ACTION, AND INFILTRATION (Added)

108.1 General

This chapter is concerned with airborne attack, guerrilla action and infiltration. For detailed information concerning these subjects, consult FM 31–15 and FM 31–20.

108.2 Airborne Characteristics

Airborne operations are characterized by speed of movement and flexibility in choice of objectives, and are effected through the mediums of surprise and shock action. Attacks of this type are generally organized into three phases.

a. A preparatory period of bombardment which will vary as to interval and concentration. Spasmodic bombing may be expected several days before the actual attack, while a single concentrated bombardment will often immediately precede the drop or landing of assault troops. In order to facilitate the element of surprise, these bombardments are sometimes omitted entirely.

b. The initial landing and subsequent reorganization of airborne troops with the establishment of an airhead as the objective.

c. A followup period of reinforcement which usually includes parachute or air-landed units to exploit initial gains and consolidate the original landing.

108.4 Capabilities and Limitations

Airborne forces, due to their unique methods of operation, possess certain distinct capabilities and limitations. A thorough knowledge of these characteristics will assist the rear area defense commander in establishing adequate defensive protection for his area of responsibility. The specific capabilities and limitations are listed in FM 57–30.

108.5 Assault Areas

Airborne units may make assault landings either directly on an area defended by AAA or in a location which is in proximity to the AAA defended zone. The AAA-defended area should be organized as the center of fixed defenses when intelligence estimates indicate the likelihood of an attack directly on the defended area. Antiaircraft weapons should be situated so as to provide maximum firepower in the area above the position, and should be further prepared to direct continuous fire on enemy paratroopers as they descend to the ground and after they have landed. All routes and approaches to the defended area should be covered by fire from prepared firing positions. Special security measures must be taken as precautions against airborne landings in suitable areas proximate to the defended position. Passive defense measures should be utilized to render drop zones inaccessible to airborne troops.

108.6 Planning Defense Against Airborne Attacks

Plans for defense against an airborne attack should include the following considerations:

a. Intelligence estimates of enemy airborne capabilities.

b. Location of suitable drop and landing zones, and their relation to remunerative targets.

c. Reconnaissance of surrounding areas to include selection of firing sites and available routes to the positions.

d. Designation of units which will participate in antiairborne operations for each probable drop and landing zone.

e. Survey data for all potential drop and landing zones. Concentration numbers should be assigned in order to facilitate the firing of medium and heavy AAA into probable drop and landing zones. Consult FM 6-40 and FM 6-20 for more detailed information on firing against ground targets.

f. Establishment of forward positions for light AAA weapons which will cover probable drop zones. Self-propelled units will be most effective in this role.

g. Detailed rehearsals to determine the adequacy of tactical plans and accompanying logistical support. All available units should participate in these rehearsals.

108.7 Conduct of the Defense

Aggressive action, characterized by speed and flexibility on the part of the defender, must be the basis for the conduct of a successful defense against airborne attack. Offensive action is necessary to exploit the difficulties an airborne force encounters in its initial landing and subsequent period of reorganization. Although adequate AAA defenses are a prerequisite for successful antiairborne operations, they in themselves offer no promise of defeating an airborne attack unless they are integrated with infantry attack on the airhead.

108.8 Defense Against Guerrilla Action and Infiltration

The perimeter defenses discussed in FM 44–2 for light AAA and FM 44–4 for medium and heavy AAA will provide antiaircraft artillery units with adequate defenses against guerrilla action and infiltration.

108.9 Security

a. Security embraces all measures taken by a command to protect itself against harassment, surprise, and observation by the enemy.

b. It is the responsibility of each unit commander to provide security against airborne, guerrilla, or similar forms of attack.

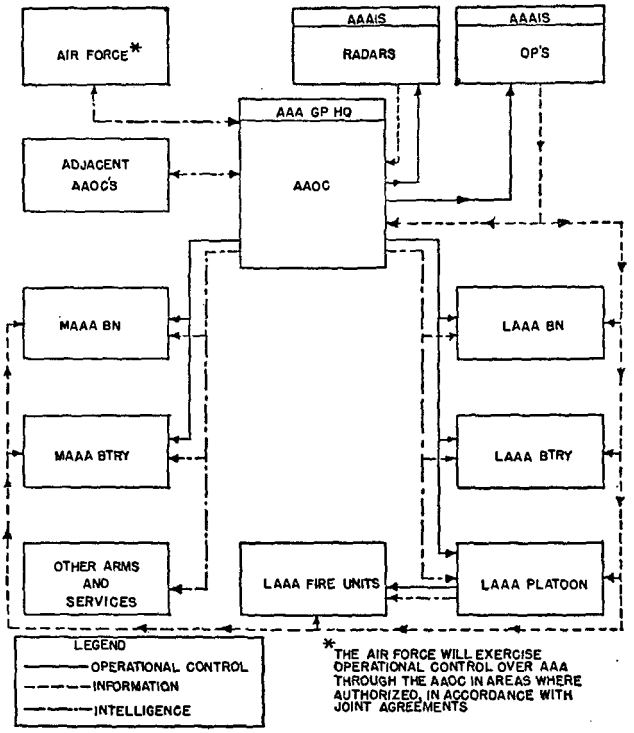


Figure 32. (Superseded.) *AAOC—AAAIS relationship (AAA group level).*

APPENDIX III

In table III delete the twenty-four 40-mm fire units on the 500-yd ring corresponding to a vulnerable area 5,000 yards in diameter.

Delete the note.

NOTES
(Added)

1. One battery is the minimum amount of light AAA that should be allocated to the defense of a vulnerable area.

2. When allocating light AAA for the defense of single vulnerable areas, no interpolation should be carried out between figures in this table except in cases similar to the situation outlined in note 3.

3. In cases of two or more defenses which cannot be integrated and each of which requires more than one battery for defense, it is permissible to interpolate within this table.

Example: To be defended: two widely separated vulnerable areas, each of which has a maximum diameter of 750 yards.

Light AA available: three batteries.

Solution: One and one-half batteries are allocated to the defense of each vulnerable area. (It is undesirable to subdivide a battery into units of smaller than platoon size.)

4. In those cases where multiple vulnerable areas in proximity to each other are to be defended by light AAA, the integration of their defenses may produce a saving in fire units. However, the fire units so saved should not be removed from the integrated defense unless they are sufficient in number to make up a usable increment which can be deployed in the defense of another vulnerable area.

[AG 322 (9 Jun 54)]

BY ORDER OF THE SECRETARY OF THE ARMY:

M. B. RIDGWAY,
General, United States Army,
Chief of Staff.

OFFICIAL:

JOHN A. KLEIN,
Major General, United States Army,
The Adjutant General.

DISTRIBUTION:

Active Army:

Tec Svc, DA (1)	AA Regt (3)
Tec Svc Bd (1)	FA Regt (1)
AFF (25)	AA Bn (3)
Army AA Comd (10)	FA Bn (1)
OS Maj Comd (5)	AA Co (2)
AFFE (50)	USMA (10)
OS Base Comd (3)	Gen & Br Svc Sch (2)
Log Comd (2)	AA Sch (50)
MDW (5)	FA Sch (50)
Armies (5)	PMST FA ROTC units (2)
Corps (3)	PMST AA ROTC units (2)
Div (5)	Mil Dist (3)
AA Brig (3)	
FA Brig (1)	

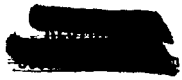
NG: Same as Active Army except allowance is one copy to each unit.

USAR: Same as Active Army except allowance is one copy to each unit.

Unless otherwise noted, distribution applies to ConUS and overseas.

For explanation of abbreviations used, see SR 320-50-1.

U. S. GOVERNMENT PRINTING OFFICE: 1954



This manual supersedes FM 4–100, 28 June 1943

CHAPTER 1

INTRODUCTION

1. PURPOSE AND SCOPE

This manual covers the fundamentals of employment of antiaircraft artillery in combat and contains the organization, characteristics, missions, supply, movement, and tactical employment of antiaircraft artillery units. The manual is intended as a guide for all commanders and staff officers who are concerned with the employment of antiaircraft artillery. For the organization, tactics, and techniques of the antiaircraft artillery battery and battalion, refer to FM 44–2 and FM 44–4.

2. DEFINITIONS

See appendix II for glossary of definitions.

3. REFERENCES

See appendix I for publications pertaining to antiaircraft artillery and allied subjects.



CHAPTER 2

MISSION

4. MISSION

The mission of antiaircraft artillery is to attack and destroy hostile targets in the air, on the ground, and on the water. This mission is logically divided into an air defense mission and a surface mission.

5. DETERMINATION OF MISSION

a. Commanders whose force includes antiaircraft artillery assign it that mission, air defense, or surface, dictated by consideration of the greatest threat to the accomplishment of the over-all mission of the force.

b. AAA will be so emplaced as best to accomplish the assigned mission. Whenever possible, without prejudice to the assigned mission, it will be sited so as to facilitate the performance of other missions.

CHAPTER 3

TACTICAL ORGANIZATION

Section I. CLASSIFICATION OF ANTIAIRCRAFT ARTILLERY

6. CLASSIFICATION SYSTEM

Fire units of antiaircraft artillery are classified according to caliber, weight, and transport.

7. CALIBER AND WEIGHT

Antiaircraft artillery is classified according to caliber and weight, as light, medium, and heavy.

a. Light Antiaircraft Artillery. Conventional antiaircraft artillery pieces, usually under 90-mm, the weight of which in a trailed mount, including on-carriage fire control, does not exceed 20,000 pounds. Self-propelled versions are rated in the same category as the trailed version.

b. Medium Antiaircraft Artillery. Conventional antiaircraft artillery pieces, 90-mm or larger, the weight of which in a trailed mount, excluding on-carriage fire control, does not exceed 40,000 pounds.

c. Heavy Antiaircraft Artillery. Conventional antiaircraft artillery pieces larger than 90-mm, the weight of which in a trailed mount is greater than 40,000 pounds.

8. TRANSPORT

Antiaircraft artillery is classified according to means of transport as towed, self-propelled, and airborne.

a. Towed Antiaircraft Artillery. AAA weapons designed for movement as trailed loads behind prime movers.

b. Self-Propelled Antiaircraft Artillery. AAA weapons permanently installed on vehicles which provide motive power for the piece. These weapons are fired from the vehicle.

c. Airborne Antiaircraft Artillery. AAA weapons specially designed for employment in assault landings made from the air.

Section II. MAJOR ANTIAIRCRAFT ARTILLERY ECHELONS

9. ARMY ANTIAIRCRAFT COMMAND

An Army antiaircraft command now exists only in the continental United States. Its major mission is to command all of the AAA forces allocated to the air defense of the United States; to provide adequate representation of AAA officers on the staff of the commander of the Air Defense Command (ADC); and to provide antiaircraft artillery defense for vulnerable areas* in the continental United States in accordance with jointly approved air defense plans. It has subordinate headquarters which perform similar command and staff functions in their respective areas.

* Throughout this text where the term, vulnerable area(s) is used, the term, vulnerable point(s) is included where applicable.

10. ANTIAIRCRAFT ARTILLERY BRIGADE

The antiaircraft artillery brigade consists of a brigade headquarters and headquarters battery and such AAA groups, battalions, operations detachments and other units as may be assigned or attached. The purpose of a brigade is to provide tactical control and administrative supervision of two or more AAA groups.

11. ANTIAIRCRAFT ARTILLERY GROUP

The antiaircraft artillery group consists of a group headquarters and a headquarters battery and such AAA battalions, operations detachments and other units as may be assigned or attached. The purpose of a group is to provide tactical control and administrative supervision of two or more battalions.

12. ANTIAIRCRAFT ARTILLERY BATTALION GROUP

When one or more battalions are attached to another battalion, a battalion group is formed. The battalion group headquarters has the same function as the AAA group headquarters. For a detailed discussion of a battalion group, see FM 6–20.

13. ANTIAIRCRAFT ARTILLERY BATTALION

An antiaircraft artillery battalion consists of a battalion headquarters and a headquarters battery and three or four firing batteries. The battalion is the basic, tactical administrative unit.

14. ANTIAIRCRAFT DEFENSE COMMAND

An antiaircraft defense command normally is established for each antiaircraft defended area by one of the major AAA echelons. However, if two or more defended areas are close enough together so that their defenses can be integrated, one antiaircraft defense command will be established for both areas. This command will exercise the necessary direct operational control over all Army AAA elements (and over Navy AAA elements when directed by an appropriate commander) involved in the defense of the area.

CHAPTER 4

COMMAND

Section I. ARTILLERY COMMANDERS

15. GENERAL

In armies, corps, and divisions, the senior officer in the artillery headquarters or section is the artillery commander and functions as the artillery officer on the special staff. The senior officer in the artillery section of an army group or higher headquarters is designated as the artillery officer. The army, corps, and division artillery commanders command all artillery (field, antiaircraft, rocket, and guided missile units) retained under army, corps, and division control, respectively. These artillery commanders act as advisers to their respective commanders on artillery matters.

16. COMMANDER, ARMY ANTIAIRCRAFT COMMAND

The Army antiaircraft commander, for the air defense of the continental United States, has the following principal duties:

a. Serves as commander of the Army units allocated for the air defense of the United States.

b. Serves as the principal adviser to the commanding general, Air Defense Command on antiaircraft matters.

c. Represents the Chief of Staff, United States Army, at lower than Department of the Army level, on all matters pertaining to air defense of the United States which are beyond the purview of the Chief, Army Field Forces (AFF). This includes planning for the air defense of the United States in coordination with the Air Force and Navy and coordinating broad policy problems arising therefrom.

d. Develops detailed plans for the tactical deployment of AAA units allocated for the air defense of the continental United States, and makes recommendations for desired changes in the current plans for the over-all employment of such units.

e. Supports the air defense commander on the basis of joint agreements between the Department of the Army and the Department of the Air Force pertaining to policies and procedures for joint air defense of the continental United States. The Army Antiaircraft Command (ARAACOM) will participate in the air defense system for the continental United States as the Army component of a joint force.

f. In coordination with the Chief, Army Field Forces, maintains close cognizance of the training and status of readiness of all AAA units potentially available to the Army Antiaircraft Command, and makes recommendations to the Chief, AFF, with reference thereto where appropriate and necessary.

g. Coordinates matters pertaining to the artillery support of harbor defenses by AAA units with the appropriate agencies of the Navy.

17. REGIONAL ARMY ANTIAIRCRAFT COMMANDERS (UNITED STATES)

The commander of each of these regional commands will have the following principal duties:

a. Serve as commander of Army units allocated to the air defense of his respective area.

b. Serve as the principal antiaircraft adviser to the Air Defense Force commander.

c. Will be responsible for the development of detailed plans for the AAA defense of its air defense region.

d. Coordinate with appropriate agencies of the Navy in matters pertaining to the artillery support of harbor defenses by AAA units.

e. Coordinate with appropriate agencies of the Navy in matters pertaining to the employment of available naval antiaircraft elements in established AA defended areas.

f. Through coordination with appropriate Army commanders, will maintain cognizance of the state of training and operation efficiency of AAA units tentatively designated for its air defense region.

18. AAA BRIGADE COMMANDER

Whether the AAA brigade is operating in the zone of interior, in the communications zone, in

the combat zone, or as part of a task force, the basic duties and responsibilities of the brigade commander are the same. The brigade commander is responsible for the tactical and operational control and administrative supervision of all units assigned or attached to the brigade. This includes the following specific items:

a. Tactical employment and deployment of all units assigned or attached to the brigade. This includes groups, battalions, operations detachment, and other units.

b. Establishment and operation of an antiaircraft operations center (AAOC) for each defended area.

c. Issuance of such necessary operational instructions as are demanded by the situation.

d. Preparation of plans and standing operating procedures (SOP) to guide the fire unit commanders in the selection of proper targets.

e. Establishment of conditions of readiness and the transmission of the alert status to fire units.

f. Establishment and operation of an antiaircraft artillery information service (AAAIS) for each defended area.

g. Supervision of all training of units assigned or attached to the brigade. This includes preparation of training programs, allocation of training resources, administering training tests, and the correction of training deficiencies.

h. Supervision of supply and administration. This includes determining that the supply and administrative support for subordinate units is ade-

quate and that these units are being properly supplied and administered (this does not mean that the brigade commander will furnish such support to subordinate units.)

i. Issuance of instructions as to the allocation of ammunition when necessary.

j. Establishment of the necessary liaison with adjacent, higher and lower units of the Army, Navy, and Air Force.

k. Supervision of the preparation and rendition of reports required by higher headquarters.

l. When operating with the field army, the senior brigade commander will act as the adviser to the artillery commander on all AAA matters.

m. When in an air defense area in which the air force is responsible for the air defense, he will act as an adviser to the appropriate air defense commander on all AAA matters.

n. Recommendations when appropriate, for rules for identification and recognition, rules for engagement, and the establishment or cancellation of restricted areas.

19. AAA GROUP COMMANDER

When an AAA group is operating independently, the group commander has the same functions and responsibilities as the brigade commander. When operating under a brigade, the group commander will have those functions and responsibilities as are directed by the brigade commander.

20. AAA BATTALION GROUP COMMANDER

The AAA battalion group commander is designated by the authority establishing the battalion group. He will have the same functions and responsibilities as the group commander in addition to commanding his own battalion.

21. AAA BATTALION COMMANDER

The battalion commander is responsible for the administration and tactical employment of the battalion. He has such other functions and responsibilities as may be directed by the group or brigade commander when the battalion is assigned or attached to one of these echelons (FM's 44–2 and 44–4).

22. AA DEFENSE COMMANDER (AADC)

For each AA defended area(s) there will be an AA defense command. It will be commanded by an AA defense commander (see par. 14). This commander is the senior (or designated) AAA officer present. As AA defense commander he exercises direct operational control over all Army AAA elements (and over Navy AAA elements when directed by an appropriate commander) in the defense.

Section II. ANTIAIRCRAFT ARTILLERY STAFF

23. GENERAL

The staff of an antiaircraft artillery commander will consist of those officers authorized under ap-

propriate tables of organization and equipment or tables of distribution. The duties of each staff officer are in general as set forth in FM 101–5. Exceptions and amplification of duties are discussed below. For a type organization of a brigade and group staff, see figures 1 and 2.

24. EXECUTIVE OFFICER

The executive officer of an AAA staff performs the duties as set forth in FM 101–5 for the Chief of Staff. The war room referred to in the list of duties is the AAOC.

25. INTELLIGENCE OFFICER (S2)

The intelligence officer performs the duties as set forth in FM 101–5. These duties will include; in coordination with the S3, the establishment and operation of the Antiaircraft Artillery Information Service; the training of officers and men in target recognition; and, in coordination with the communications officer, he will keep units of the command informed on recognition signals.

26. RADAR OFFICER

The duties of the antiaircraft artillery radar officer are as follows:

a. Advises the commander and staff on all radar matters.

b. Advises and aids the S3 in organizing and supervising radar training programs.

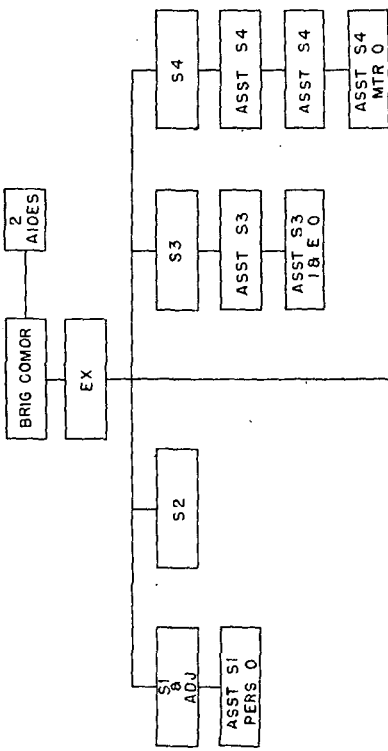


Figure 1. A type organization of a brigade staff.

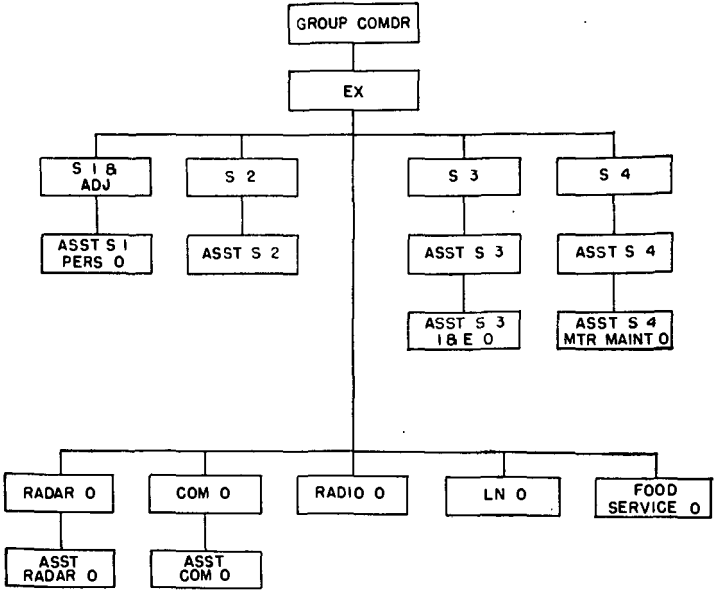


Figure 2. A type organization of a group staff.

c. Submits necessary reports and keeps pertinent records.

d. Supervises radar maintenance.

e. Provides liaison on radar matters with higher headquarters.

f. Advises S2 and S3 on AAAIS coverage of defense.

g. Advises and assists supply officer in procurement of radar supplies.

h. Maintains clutter and coverage diagrams in the AAOC.

27. OTHER STAFF OFFICERS

Duties of other antiaircraft artillery staff officers are as set forth in FM 101–5.

CHAPTER 5

AIR DEFENSE

Section I. INTRODUCTION

28. GENERAL

Air defense, as defined by the Joint Chiefs of Staff, includes all measures designed to nullify or reduce the effectiveness of the attack of hostile aircraft or guided missiles after they are airborne. The Joint Chiefs of Staff have allocated a portion of the military resources of the United States to air defense in order that the United States may prevent hostile air activity from effectively interfering with our war efforts or national interests.

29. ALLOCATIONS OF RESOURCES

The amount of resources allocated to air defense will change as the war progresses. Initially, the allocation probably will be large in all categories and will increase during the early phases of the war. But, as superiority over the enemy air force and missile capabilities is attained, the need for air defense and, consequently, the resources allocated will appreciably decrease until at the end of the war there will be little, if any, military resources allocated for this purpose.

30. MEANS OF DEFENSE

a. The following means are available for air defense:

(1) *Active*—Direct defensive action taken to destroy or reduce the effectiveness of an enemy air attack. Active air defense includes such measures as the use of fighter aircraft, antiaircraft artillery, electronic countermeasures, and ground (ship)-to-air guided missiles.

(2) *Passive*—All measures, other than active defense, taken to minimize the effects of hostile air action. These include the use of cover, concealment, camouflage, and dispersion.

b. In order to reduce the commitment of military forces to air defense missions, maximum use of passive measures and nonmilitary personnel must be made. In certain vulnerable areas both in the zone of interior and the theaters of operations, there will be an allocation of interceptor aircraft for general air defense of the area. At certain vulnerable areas in the continental United States and theaters of operations, AAA will be provided for local air defenses. Because of its limited availability AAA will be assigned for protection of only the most vital vulnerable areas.

Section II. PRIORITIES FOR AIR DEFENSE

31. GENERAL

As stated above, usually there will be insufficient means to carry out air defense of all vital

areas. It is therefore necessary to determine priorities for air defense and allocate means to vital areas both in the continental United States and overseas theaters. The determination of the priorities and allocation of means is a continuous process.

32. CRITERIA

The following are the basic criteria in determining priorities for air defense:

a. Selection. Selection of vital areas which are most necessary for the accomplishment of the over-all mission.

b. Assailability. The enemy's ability to hit the particular installation which is desired to be kept in operation.

c. Vulnerability. The degree of susceptibility of a particular installation to damage from a given type and/or weight of attack by the enemy.

d. Recuperability. The ease and speed with which an installation can be rehabilitated in case it is damaged or destroyed by enemy attack.

e. Criticality. A measure of the importance of an installation in relation to alternate means which will provide the same contribution to the military potential.

Section III ALLOCATION OF MEANS

33. ALLOCATION CONSIDERATIONS

Having determined the priorities for air defense, it will next be necessary to allocate the

means available. The following general considerations affect the employment of interceptor aircraft and antiaircraft units in the air defense mission. Each should be allocated:

a. In accordance with one plan.

b. On the basis of availability.

c. To exploit its capabilities and to minimize the effect of its limitations in order to contribute the most to the over-all air defense.

34. ANTIAIRCRAFT ARTILLERY ALLOCATION

The following additional considerations will affect the allocation of antiaircraft artillery to the various local defenses:

a. Amount and types of AAA available.

b. Other air defense means which are available.

c. Priorities established in paragraph 32.

d. Enemy tactics and capabilities as compared to the nature of the vulnerable area.

e. Minimum defense needs.

f. Civilian or military morale.

g. Importance of the vulnerable area to the accomplishment of the mission. It is under this heading that the determination of how much additional AAA, over and above the minimum defense needs, will be allocated to any one vulnerable area.

Section IV. RESPONSIBILITY FOR DETERMINATION OF PRIORITIES AND ALLOCATION OF MEANS

35. GENERAL

a. Only the Joint Chiefs of Staff are in a position to assess the importance of the vulnerable

areas in the continental United States and the requirements in the various theaters. Therefore, only the Joint Chiefs of Staff can make the final determination of priorities and allocation of military resources to air defense (JAAF Bulletin No. 13, 13 May 48).

b. In order that the Joint Chiefs may be assisted in the determination of priorities and the allocation of resources, they will require a plan for the air defense of the United States and recommendations from theater commanders for the defense of their respective areas. When these have been assessed and matched to the means available, a final allocation of air defense resources will be made by the Joint Chiefs of Staff.

36. RESPONSIBILITY, CONTINENTAL UNITED STATES

The Chief of Staff, United States Air Force, is responsible for preparing and submitting the plan for the air defense of the continental United States to the Joint Chiefs of Staff. This plan, when approved, will delineate the vital geographical areas in the continental United States to be afforded air defense and will set forth the priorities for such defense. It will recommend the allocation of both interceptor aircraft and AAA to the various regions, vulnerable areas, and vulnerable points. When this plan is approved it will form the basis for the deployment of forces in the air defense of the continental United States. In the absence of such an approved plan from the Joint Chiefs of Staff, the priorities for defense and the alloca-

tion of AAA will be determined by mutual agreement between the Department of the Army and the Department of the Air Force. In the absence of such an agreement it may be necessary for the Commanding General, Army Antiaircraft Command to formulate an agreement with the Commanding General, Air Defense Command, as to the priorities and allocations of AAA.

37. RESPONSIBILITY, THEATER OF OPERATIONS

In a theater of operations, final determination of the priorities for air defense and the allocation of military means thereto will be made by the theater commander. He will recommend to the Joint Chiefs of Staff the resources necessary and will plan for the suballocation of those resources that are allocated to the theater. In making a theater air defense plan, the requirements of all services and the civilian population in the theater will have to be considered and consolidated. In order to assist the theater commander in his air defense plan, there may be set up an air defense committee to investigate the requests for air defense resources of the three military services and those agencies concerned with civil needs. The theater commander will suballocate air defense resources to the combat and communications zones.

38. RESPONSIBILITY, COMBAT ZONE

The determination of priorities and the allocation of resources in the combat zone is prescribed by the theater commander and usually is a joint

responsibility shared equally by the senior Army commander and the senior tactical Air Force commander, and/or the senior Naval commander present. They carry out this responsibility by consideration of mutual requirements and the requirements for air defense of the elements of all services which may be present in the combat zone. Responsibility for the employment and the allocation of antiaircraft resources rests with the senior Army commander. Based upon this determination AAA is usually allocated to subordinate Army units, such as army, corps, and division.

39. RESPONSIBILITY, COMMUNICATIONS ZONE

Responsibility for determining priorities and allocation of resources in the communications zone lies with that commander who is responsible for the air defense of the communications zone. This commander may be appointed by the theater commander or the communications zone commander if such authority has been delegated to him by the theater commander. He must consider the requirements for air defense of the three armed services and the civilian population. He must give special consideration to the air defense requirements of those elements most necessary to carry out the mission of the forces in the communications zone.

CHAPTER 6
ORGANIZATION FOR AIR DEFENSE

Section I. INTRODUCTION

40. GENERAL

The air defense organization for any area, whether it be in the combat zone, the communications zone, or the continental United States, will be organized and designed with the objective of obtaining the maximum results from the air defense resources provided. Such an organization will require centralized operational control under one commander with all elements of the defense coordinated. All elements engaged in air defense must understand the organization, functioning, and capabilities of the other elements.

41. FLEXIBILITY

AAA organizations possess an inherent flexibility which enables them to be organized in the pattern that will best fit the needs of any specific air defense.

Section II. ORGANIZATION FOR THE AIR DEFENSE OF THE CONTINENTAL UNITED STATES

42. ORGANIZATION
(figs. 3 and 5).

a. General. In order to carry out its responsibilities for the air defense of the continental

United States, the United States Air Force has established the Air Defense Command. This command has a number of subordinate air defense forces. Under each of these air defense forces are a number of Air Divisions (Defense), with each division having an Air Defense Control Center (ADCC) and one or more Air Defense Direction Centers (ADDC) commonly called Ground Control Intercept (GCI) stations. The Air Division (Defense) (ADD) is the highest air force echelon which will exercise operational control of all the elements of air defense in an assigned area. The ADD commander exercises this operational control through his tactical command post, the ADCC. Subordinate ADDC's are provided primarily to control intercepts but in many cases they may be delegated the functions of the ADCC. The Air Division (Defense) has assigned to it one Aircraft Control and Warning Group. An interceptor wing(s) is assigned to the Air Defense Force and placed under the operational control of the Air Division (Defense). The Aircraft Control and Warning Group operates the ADCC, ADDC, and other means of control and warning.

b. Army AAA Organization (figs. 4 and 5). In order to insure coordination of the AAA with other defense measures the Army has established a parallel system of command and control. The Army Antiaircraft Command was established to command all of the AAA forces allocated to the air defense of the United States and to provide adequate representation of AAA officers on the staff of the commanding general, Air Defense

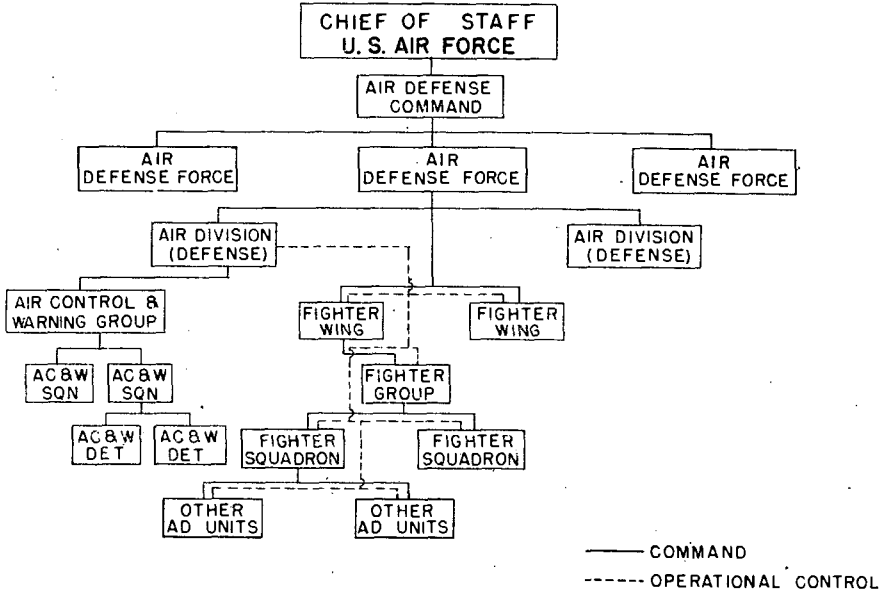


Figure 3. Air defense command structure.

Command. Subordinate regional Army antiaircraft commands have been established to parallel the air defense forces. Assigned or attached to these regional Army antiaircraft commands will be brigades, groups, battalions and operations detachments. In areas where AAA defenses will be established, provisions have been made for the AAA commander to augment the staff of the Air Division (Defense) commander as a principal AA adviser and to provide liaison between the ADCC and the AAOC. AA representation will be provided at the appropriate ADDC to ensure the ready exchange of information between the AAOC and the ADDC.

43. COMMAND, CONTROL, AND COORDINATION (fig. 5)

a. Air Defense Command (ADC) level. The commander of the Army Antiaircraft Command (ARAACOM) is directly responsible to the Chief of Staff, United States Army, except for operational control which will be exercised by the commander of the Air Defense Command (ADC), in accordance with doctrine and procedures approved by the Joint Chiefs of Staff. In the absence of such doctrines and procedures, operational control will be exercised in accordance with joint agreements between the Department of the Army and Department of the Air Force. The air defense commander will exercise operational control over all elements of the air defense system. He will exercise this operational control at the ADC-ARAACOM level by:

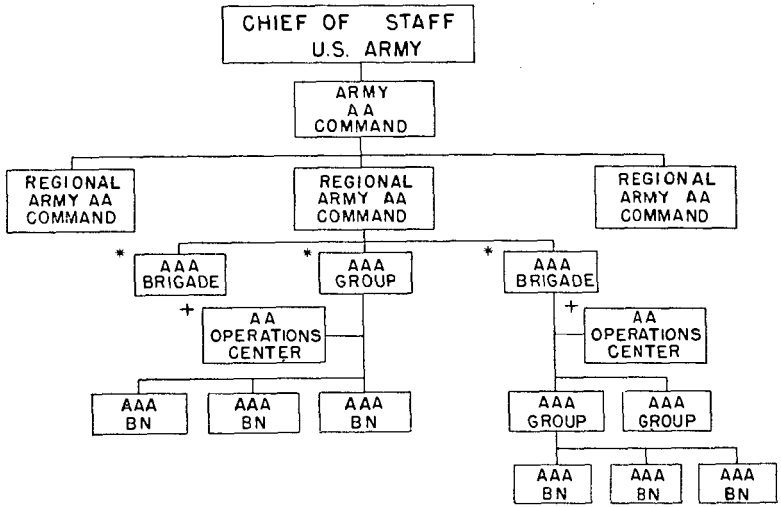


Figure 4. Army AA command structure.

(1) The preparation of integrated plans for the air defense of the continental United States to include recommendation for allocation of resources to the various vulnerable areas in the United States.

(2) The establishment of joint* doctrines and procedures based upon decisions of the Joint Chiefs of Staff and agreements by the Department of the Army and the Department of the Air Force.

b. Air Defense Force Level. The air defense commander at the air defense force level will exercise operational control by:

(1) The preparation and execution of detailed plans for the air defense of his respective area.

(2) Amplification, if necessary, and promulgation to subordinate units, of joint doctrines and procedures as discussed in *a*(2) above.

c. Air Division (Defense) (ADD) Level. The air defense commander at the ADD-Brigade (group, battalion) level will exercise operational control by:

(1) Detailing the antiaircraft action status, that is, release fire or hold fire. The normal action status is release fire.

(2) Establishing SOP's for local areas based upon jointly agreed rules and procedures.

* This includes, along with many other items, such things as SOP's, rules of engagement, rules for identification, and definitions such as hostile acts and restricted areas.

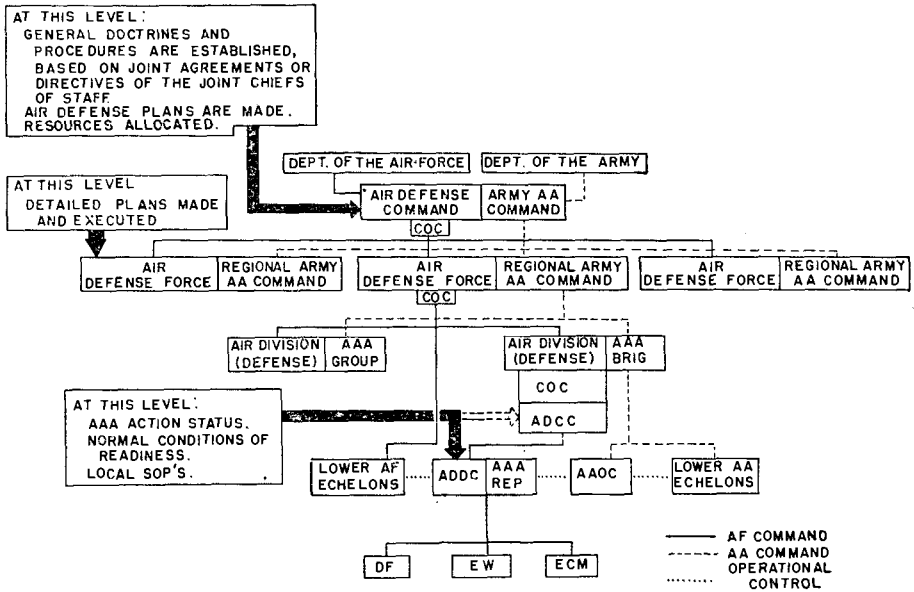


Figure 5. Army AA Command structure superimposed on Air Defense Command structure.

(3) Prescribing the appropriate status of alert for each AAA defense.

d. Tactical Location of AAA. The tactical location of AAA units at each defended area is a function of the AAA commander.

e. Logistical and Administrative Support. Continental Army commanders will render logistical and administrative support to all elements of the Army Antiaircraft Command as requested by the appropriate echelons within the respective Army areas.

f. Joint Air Defense Training. The commander of the Air Defense Command will be responsible for the carrying out of joint air defense training and joint air defense exercises and maneuvers. This will be done in accordance with approved plans, utilizing units of other components of the Department of Defense that may be available.

Section III. ORGANIZATION FOR AIR DEFENSE IN THEATER OF OPERATIONS

44. GENERAL

The theater commander is responsible for the air defense of his respective theater. The type of air defense organization for any particular area will depend upon a number of factors. Defense requirements for the Army, Navy, Air Force, and any other service in the area, plus the civilian population will be considered. The defense elements available, the size and configuration of the theater, the distance from enemy bases, the type

and number of vulnerable areas within the theater, the strength, tactics, techniques, and capabilities of the enemy air force are all factors that will influence the air defense plan of the theater and its organization. The air defense resources allocated to the theater will be suballocated to the communications zone and the combat zone.

45. COMMUNICATIONS ZONE

a. The responsibility for the air defense of the communications zone may be delegated to an air defense commander appointed by the theater commander or one appointed by the communications zone commander if such authority has been given to him by the theater commander. The air defense plan will consider the requirements of the services present in the zone and the civilian population. The organizational structure will depend upon the air defense resources available, fighter aircraft and AAA, plus the other factors listed in paragraph 44.

b. The command and control relationships will depend upon the defense organization established. It may be patterned after the continental United States air defense organization, the combat zone organization, or a combination of both.

46. COMBAT ZONE

a. In the combat zone the army commander is responsible for the air defense of his area. A plan is formulated by representatives of the various services present in the zone and approved by the

commander concerned. Based upon this plan AAA units are usually allocated to subordinate Army units such as army, corps, and divisions.

b. The command and control relationships of AAA units with army, corps, and division are as described in paragraph 48.

47. AAA IN DIVISION

Each division (armored, infantry, airborne) has one organic light AAA battalion. The light AAA battalion organic to the infantry and armored divisions contains four self-propelled firing batteries. The light AAA battalion in the airborne division contains three airborne firing batteries. The AAA battalion organic to the infantry (armored, airborne) division is part of the division artillery and is commanded by the division artillery commander. If an additional battalion is attached to a division, it becomes part of a battalion group, commanded by the commander of the organic battalion. If the attached AAA includes a group, the organic battalion becomes subordinate to the group, which in turn is subordinate to division artillery.

Section IV. COMMAND, CONTROL, AND COORDINATION IN THE COMBAT ZONE

48. GENERAL

All artillery units, field (including surface-to-surface missiles), and antiaircraft (including surface-to-air missiles), are under one command. The

army artillery commander commands all artillery allocated to the army and which has not been further assigned or attached to other commands; likewise, in the corps and division, the artillery commander commands all artillery assigned or attached to the respective command and not further assigned or attached to other commands. Normally, tactical fire control of antiaircraft artillery units engaged in air defense will be exercised through antiaircraft channels (AAOC to AAOC to fire units). Such delegation of tactical fire control does not relieve the artillery commander of his responsibilities and prerogatives of command. Army, corps and division SOP's normally will provide for the necessary centralized direction of AAA units engaged in air defense.

49. ANTIAIRCRAFT ARTILLERY IN THE DIVISION AREA

The division commander will determine the mission (air defense or surface) of the AAA which is assigned or attached to the division. He will establish the priority for the air defense of the installations within the division area and will determine the allocation of his antiaircraft artillery to these vulnerable areas. Effective air defense requires the highest degree of coordination and, whenever possible, centralized tactical fire control of all air defense elements deployed in the corps zone of action (including division areas.) Through coordination, integration of defenses in division and corps areas can be obtained, resulting in a saving of matériel and providing a stronger over-

all AA defense. Due to the speeds of modern aircraft, similarity in designs, and time and space factors involved, it is desirable, where the tactical situation permits, to centralize tactical fire control of AA air defense elements. A method of obtaining this control is through Corps AAOC exercising tactical fire direction over all AA elements (division, corps and army) deployed within the division and corps areas. Information of aerial activity (friendly and hostile) comes primarily from the TACC or TADC. The corps AAOC establishes liaison with the TACC (TADC) and is normally located near this control center. The rapid transmission of information of aerial activity is essential in obtaining maximum AA effectiveness against hostile aircraft and security for friendly aircraft. The corps AAOC is equipped and located to provide this rapid transmission of aerial activity down to division level. Even if the situation dictates that the centralized tactical fire control noted above is not practical for division AAA units, the division and other AAOC's still will receive aerial information with the least possible delay and the division commander will be able to control, accordingly, any divisional weapons whose fires might interfere with friendly aerial activity. When the mission, priority, or allocation of any AAA unit(s) deployed in an integrated defense is to be changed, the integrity of established AA defenses can be maintained by proper coordination and concurrent planning between the commanders concerned. This will permit the redesign of integrated defenses.

50. ANTIAIRCRAFT ARTILLERY IN CORPS AREA

The corps SOP normally will provide for coordinated action and centralized control through the senior AAA commander in the corps exercising control over all AA elements deployed within the geographical limits of the corps area and assigned an air defense mission (par. 49). This control does not include the assignment of missions (air defense or ground), the determination of priorities for air defense, or the allocation of units which are assigned or attached to division or army. When the mission, priority, or allocation of any AA units, deployed in an integrated defense, is to be changed, the integrity of established AA defenses can be maintained by proper coordination and concurrent planning between the commanders concerned. The senior AAA commander in the corps will establish and operate an integrated AAAIS system for the entire corps area.

51. ANTIAIRCRAFT ARTILLERY IN THE ARMY AREA

The army SOP normally will provide for centralized control through the senior AAA commander in the army exercising control of all AAA units assigned an air defense mission and deployed within the geographical limits of the army area in rear of the corps rear boundary. In order to insure the most effective use of antiaircraft artillery deployed for air defense purposes in the army service area the senior AA commander in the army will coordinate the deployment of units to form effective area defenses, and assignment of primary

sectors of fire. The senior AAA commander in the army will establish and operate an integrated AAAIS system for the army area in rear of the corps rear boundary.

Section V. TACTICAL AIR

52. TACTICAL AIR COMMAND

The tactical air command is organized, equipped, and trained to plan and conduct continual day and night operations independently or in conjunction with an army group. It is characterized by its flexibility, mobility, and ability to support ground forces. It consists of two or more tactical air forces and such additional forces, including a tactical bomber force, as may be assigned. Long range planning for the air-ground campaign is performed by tactical air command in conjunction with an army group based on the directive of the theater commander.

53. TACTICAL AIR FORCE

The tactical air force is organized, equipped, and trained to plan and conduct continual day and night operations in conjunction with a field army or a task force. It normally consists of four to six fighter wings, a reconnaissance wing, a tactical air control system, and such additional forces as may be required.

54. TACTICAL AIR OPERATIONS SYSTEM

The tactical air operations system provides a tactical air force commander with the organiza-

tion and equipment required to plan, direct, and control air operations. It is through this system that the tactical air force commander is able to achieve centralized control over his forces and integration of effort between the Air Force and the field army. The tactical air operations system consists of:

a. The combat operations section at the joint operations center.

b. The tactical air control system.

c. Air liaison officers.

d. An Air Force signal battalion.

e. Air units assigned to tactical units.

55. TACTICAL AIR CONTROL SYSTEM

a. The tactical air control group employing its organic electronic and communications facilities performs two functions:

(1) In flight control of aircraft utilized in the tactical air effort.

(2) Radar surveillance of the field army—tactical air force area of responsibility in joint operations.

b. The tactical air control system consists of:

(1) *Tactical air control center (TACC).* The tactical air control center is the focal point for aircraft control and warning activities of the tactical air force. It is an air information, communications, and control center, and has no command functions other than those specifically designated. Through this center the tactical air force commander exercises opera-

tional control over all elements of the tactical air force.

(2) *Tactical air direction center* (*TADC*). A tactical air direction center is a subordinate air control facility of the tactical air control center from which air control and warning operations within a restricted area are conducted. It is organized and equipped on a small or large scale depending upon its mission. Two or more tactical air direction centers normally are located separately within a field army-tactical air force zone of operations so as to provide maximum radar and radio control coverage.

(3) *Tactical air control party* (*TACP*). The tactical air control party is a team specially organized to direct close air support strikes in the vicinity of forward ground elements by visual methods. It is a highly mobile element of the tactical air control system which vectors aircraft to targets, and provides point-to-point communications with the tactical air control center or pertinent tactical air direction centers. It contains a forward air controller.

(4) *Tactical air direction post* (*TADP*). The tactical air direction post is a specialized control element of the tactical air control system. It performs no air warning service but is used to position friendly aircraft over predetermined target coordi-

nates, or other geographical locations, under all weather conditions. This facility consists of a very narrow beamed radar with the necessary plotting and computer components and is designed for precision navigation and pin point, all-weather bombing. The tactical air direction post must be highly mobile to allow movement into new positions according to the requirement of the tactical air mission.

56. RELATIONSHIP TO THE ANTIAIRCRAFT ARTILLERY

The ground forces and air forces when employed in joint operations function as components of a team. Close relationship is essential to the accomplishment of their respective missions. Planning and executing joint operations require close coordination and liaison in order to be successful. This cooperation and liaison extend through all echelons of the air and ground organization. Coordination in air defense is obtained through the establishment of rules of engagement, rules for identification, and the establishment of restricted areas. Minute-to-minute coordination is obtained by liaison between AAOC and either TACC or TADC. In the combat zone AAA units normally will be under the operational control of an army commander. Under certain exceptional circumstances the tactical air force commander may be delegated operational control of the antiaircraft artillery. In such cases he will exercise this control through AAA control channels.

CHAPTER 7

EMPLOYMENT OF ANTIAIRCRAFT ARTILLERY IN AIR DEFENSE MISSION

57. FACTORS AFFECTING AIR DEFENSE MISSION

There are five major factors which affect the accomplishment of the air defense mission of AAA with the means allocated.

a. Enemy Tactics, Techniques and Capabilities. The tactics, techniques, and capabilities of the enemy will change from time to time and will differ depending upon the location of the vulnerable area with respect to the enemy air bases. Generally, the enemy capabilities for attacking vulnerable areas include bombing attacks at varying levels and dive or glide attacks with rockets and guided missiles. The extent to which the enemy exercises any or all of these capabilities will be a determining factor in the siting of AAA.

b. Capabilities and Limitations of AAA Weapons. In planning AAA defense such limitations as range, dead areas, tracking rates, and the effectiveness of all fire units must be taken in account. Also, in planning certain light AAA defenses, the human element must be considered in order to obtain the maximum capabilities of light AAA weapons. The state of training and the physical and mental well-being of the fire unit crews have a great deal of influence upon the accuracy of fire.

c. Vulnerable Area. The size, shape, and nature of the vulnerable area will affect the accomplishment of the mission. The size of the vulnerable area will influence the enemy bombing run. Bombing must be more precise for smaller vulnerable areas, and longer bombing runs are required. On the other hand, little if any bombing run may be required to cause considerable damage to a larger vulnerable area. The shape of the vulnerable area may well influence the direction of attack. For instance, a long, narrow vulnerable area will necessarily canalize the attack if maximum bombing effectiveness is to be obtained. The nature of the vulnerable area will influence the type of bombs chosen by the enemy and thereby tend to dictate, in a large measure, the tactics of the enemy air force.

d. Weather and Terrain. Terrain will influence both the type and direction of attack by the enemy and also dictate the location of fire unit position areas. An examination of the vulnerable area may reveal certain very definite expected avenues of approach which are clearly dictated by terrain features. Likewise, terrain features may preclude the possibility of employing AAA weapons in optimum locations. For instance, a large body of water or a rugged mountain feature, in or near the target, may require a special design for AAA defense; it may also require an increased number of fire units or longer range guns to obtain all-around protection of the vulnerable area. In some localities, where winds are generally unvarying in direction and of high velocities, the normal di-

rection of attack will be downwind, thereby requiring that AAA defenses be offset into the wind. Other weather conditions such as extremely high or low temperatures and large amounts of rainfall may influence the siting of AAA.

e. Other Air Defense Means. The existence of other available air defense means such as, AAA in the area, larger numbers of interceptor aircraft, or passive air defense measures will influence both the amount and disposition of AAA.

58. DISPOSITION OF FIRE UNITS

In the disposition of AAA fire units, the following six basic considerations, listed in their general order of importance, must be kept in mind.

a. Balanced Defense. In general the enemy is capable of attacking equally from any direction and will certainly seek to attack from the direction that is most favorable to him. He will seek to exploit any weakness in the defense; therefore, every effort must be made to attain a balanced defense.

b. Maximum Attrition Rate. The maximum possible attrition rate must be attained. This requires that medium and heavy AAA fire units be placed as near the optimum gun ring as possible, based on the expected conditions of attack.

c. Continuity of Engagement. Once engaged, the enemy must be given no relief. He should be engaged continuously from the earliest possible moment until the final moment of bomb release. Even though a hostile aircraft is not destroyed, antiaircraft fire may divert him from his mission

or may cause him to drop his bombs with such errors as to miss the most important parts of the vulnerable area. This principle means that the dead area of a medium or heavy AAA battery must be covered by the fire of at least one of the adjacent batteries. Dead areas of light AAA are covered by one or more fire units.

d. Engagement of Targets. The maximum number of targets must be engaged. This requires that the fire unit commander select targets which are not already being engaged by other weapons of the defense. Engagements should be broken off promptly and new targets engaged when new targets offer a greater threat to the defended area or offer a more vulnerable target to the fire unit concerned.

e. Routes of Approach. Cover the most likely routes of approach. Often terrain or weather will dictate a certain route of approach for hostile aircraft. When routes of approach can be determined, weapons should be sited to provide greater strength in those areas. This must not be done, however, at the expense of weakening other portions of the defense below the minimum requirements.

f. Selection of Positions. Whenever possible, positions should be so selected that other missions can be performed from these positions without jeopardizing the air defense mission. For example, when the vulnerable area is on the seacoast, some AAA positions should be selected to carry out both the air defense mission and a seaward surface mission.

CHAPTER 8

DESIGN OF MEDIUM AND HEAVY ANTIAIRCRAFT ARTILLERY DEFENSES

Section I. INTRODUCTION

59. GENERAL

The following methods, procedures, and discussions relative to medium and heavy AAA defense designing present the principles involved in such design. The typical defense designs and analyses for medium and heavy AAA defenses are based upon the use of attrition rates. Most commanders will be presented with the problem of establishing antiaircraft defenses with limited amounts of antiaircraft matériel. Based upon the amount of matériel available and the other factors which affect the accomplishment of the mission, it follows that there will be an optimum location for the fire units insofar as the distance outward from the vulnerable area is concerned. This optimum location has been determined empirically by a consideration of attrition rates. These factors and optimum locations are contained in AAA planning factors tables. Tables I and II, appendix III are the tables now in use. These tables were derived by using appropriate fire unit analyzers and serve as guides for the planning of AAA gun

defenses. No two defenses will be exactly alike, but each must be hand-tailored, based upon the prevailing conditions under which AAA is to be employed. These tables will indicate how available matériel can best be employed to exploit its capabilities and minimize its limitations under the varying conditions of attack as set forth in the notes to the table.

60. CONSIDERATIONS OF ENEMY CAPABILITIES

Prior to the establishment of any defense it is necessary to consider the tactics and capabilities of the enemy to determine the speeds, altitudes of attack, and lengths of bomb run. Since the hostile air force may attack vulnerable areas at varying speeds and altitudes, studies were made to determine a basic defense that would provide the greatest over-all effectiveness against these varying conditions of attack. However, if intelligence sources reveal that the enemy has limited his attacks as to altitude, speed, or direction of attack, special defenses should be designed as near as possible to meet the actual and anticipated conditions.

61. LOCATION OF VULNERABLE AREA

The method of employing medium and heavy AAA in the defense of vulnerable areas will be substantially the same regardless of whether the installation is located in a combat zone or rear area. The same considerations and design procedures will apply. It must be recognized, how-

ever, that slightly different techniques involved, dependent on such items as rapidity of movement and the nature of the vulnerable area.

62. FLEXIBILITY OF DEFENSE

Constant interpretation and evaluation of the enemy's capabilities, techniques, and tactics, must be made to determine what shifting of a defense is necessary if the defense capabilities are to be improved. Provisions must be made for occupation of alternate positions to deceive the enemy. Even though the vulnerable area may be defended for a long period of time by the same unit, the defense should not be permitted to become dormant.

63. BOMB RELEASE LINE

The attack conditions determine the location of the bomb release line. The distance that this bomb release line is located from the edge of the vulnerable area can be considered as the horizontal range of the bomb under the given conditions of attack. There are several factors which can influence the distance of the bomb release line from the edge of the objective. The three most important factors are the speed and altitude of the attacking aircraft and the type of bomb used.

64. DIRECTIONS OF ATTACK

A defense must be designed against all directions of attack. However, in most instances a defense can be analyzed adequately considering only

12 different directions of attack (every 30° starting at 0°).

Section II. TOOLS FOR DEFENSE DESIGNS

65. GENERAL

In defense designs for medium and heavy AAA, certain tools have been provided to enable commanders to establish defenses expeditiously and effectively. These tools were derived from statistical analysis of data from extensive experimental firing under controlled conditions. Based upon these data a commander can now place available AAA matériel for maximum effectiveness against specific conditions of attack.

66. AAA PLANNING FACTORS TABLES

One of these tools used in planning an AAA defense is the planning factors table. The table is based upon the size of the vulnerable area and the matériel available. It will furnish the commander with optimum gun rings and average index numbers of a defense. The table is used only as a guide in planning a defense, since each defense must be hand-tailored to fit the local conditions. Tables I and II, appendix III are the 90-mm and 120-mm planning factors tables now in use.

67. FIRE UNIT ANALYZER (FUA)

a. Another tool which will aid the commander in planning a defense is the fire unit analyzer

(FUA). This is a graphical overlay printed on a transparent material that enables the user to design and analyze any medium or heavy AAA defense by measuring the relative effectiveness of all fire units in the defense against any selected direction of attack. The two categories of fire unit analyzers currently for issue are:

(1) The basic analyzer designed for altitudes of attack from 15,000—30,000 feet and speeds of 200—400 miles per hour, which is to be used for the design of defenses against varying conditions of attack.

(2) Three special analyzers for altitudes of 15,000, 20,000 and 30,000 feet and a special analyzer for the 120-mm fire unit at 35,000 feet. These analyzers are to be used in designing defenses against special conditions of attack.

Note. The altitudes as indicated above for the basic and special analyzers are altitudes measured above fire unit positions and not above mean sea level.

b. Within each category there are analyzers for each different weapon.

c. The minimum requirement is one set for each type gun battalion (90-mm and/or 120-mm) and one set for each type gun, per group, brigade, and higher AAA headquarters. A basic fire unit analyzer is shown in figure 6.

68. PRESENTING RESULTS

For convenience in presenting the results of the analysis of a defense, two forms are provided, the recording form and the effectiveness clock.

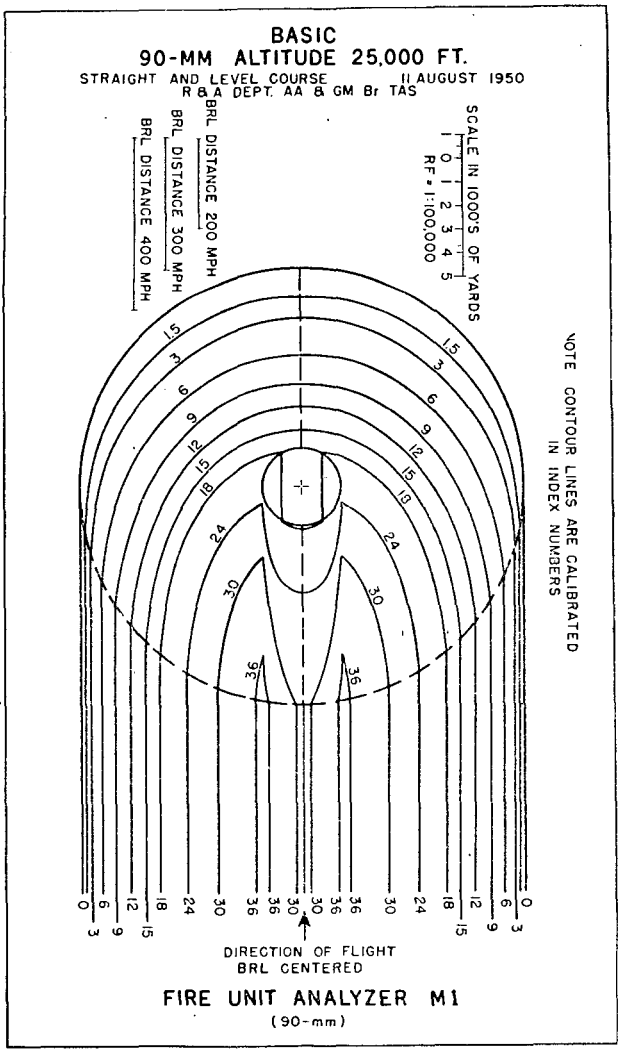


Figure 6. A fire unit analyzer (basic).

a. Recording Form. By using the appropriate fire unit analyzer, the index number contribution of each fire unit in the defense, for each direction of attack, is determined and tabulated on the recording form. Each direction of attack column is totaled to obtain the total contribution of all fire units for each direction of attack. The number of direction of attack lines which might be considered is not limited. They are put in as desired by the commander. Figure 7 is a sample recording form.

b. Effectiveness Clock. The defense analysis results are presented graphically by means of a polar coordinate chart, called the effectiveness clock. This clock is graduated in angular increments corresponding to the direction of attack lines, and radially in equally spaced concentric lines. These concentric lines are used to establish an index number scale. The shape of these lines corresponds to the shape of the bomb release line.

(1) Having chosen an appropriate scale, the total index number for each direction of attack line as shown on the recording form is plotted and these points are joined with a smooth curve. For vividness of presentation, the area enclosed in this curve should be shaded or cross-hatched.

(2) The index numbers on each analyzer are designed so they may be added to obtain the average index numbers indicated in the AAA planning factors table.

[redacted]
(when filled in)

DATE 1 SEPT 1950

RECORDING FORM

VULNERABLE AREA SAMPLE RADIUS IN YARDS 1,500

AVERAGE INDEX NUMBER (from AAA Planning Factors Table) 40

FIRE UNIT and CALIBER	DIRECTION OF ATTACK (degrees)											
	0	30	60	90	120	150	180	210	240	270	300	330
(90)	16.0	1.5								2.0	17.0	20.0
2	12.0	6.0	1.0	10.0					0.5	4.5	10.5	15.0
3	8.0	21.5	21.0	18.0	1.0							0.5
4		7.0	18.0	12.0	13.0	2.0						
5			2.0	1.0	17.5	19.0	7.0					
6					10.0	21.0	21.0	8.5	0.5			
7						1.5	11.0	19.5	20.0	7.5		
8							0.5	8.0	21.0	22.0	10.0	1.0
9												
10												
11												
12												
13												
14												
15												
16												
TOTAL INDEX NO.	36.0	36.0	42.0	41.0	41.5	43.5	39.5	36.0	42.0	36.0	37.5	36.5

RESTRICTED
(when filled in)

Figure 7. Recording form.

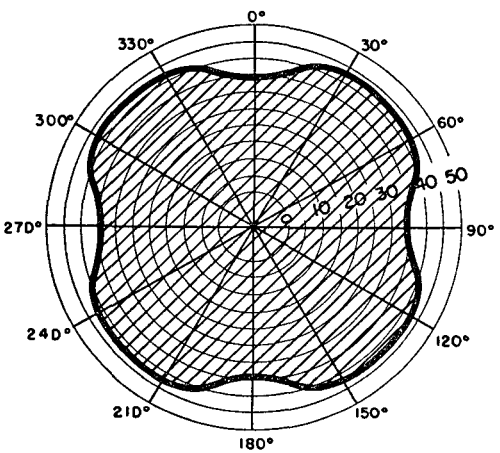
(3) This graphical clock presentation will indicate:

(*a*) Relative strength of the defense for each direction of attack in terms of relative index numbers and the balance or lack of balance of a defense.

DATE 1 SEP 1950

AA EFFECTIVENESS CLOCK

VULNERABLE AREA SAMPLE
RADIUS IN YARDS 2,000



CONDITIONS

ALTITUDE 25,000 FT
SPEED 300 MPH
WEAPONS 90-mm
REMARKS NONE

AVERAGE INDEX NUMBER (from AAA Planning Factors Table) 39

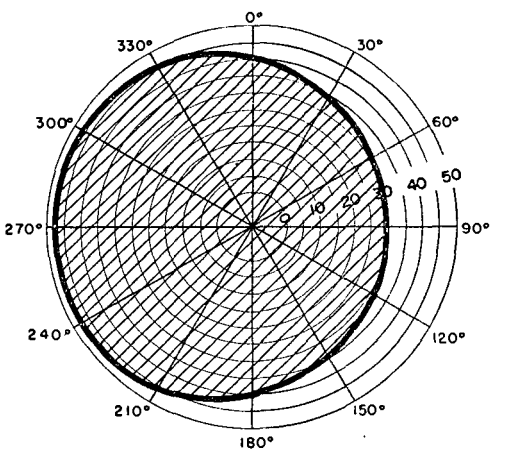
Figure 8. Effectiveness clock—balanced defense.

(*b*) It will also indicate whether the defense achieves the average index number as indicated in the appropriate AAA planning factors table. Figures 8 and 9 are examples of effectiveness clocks illustrating a balanced and unbalanced defense.

DATE *1 SEP 1950*

AA EFFECTIVENESS CLOCK

VULNERABLE AREA *SAMPLE*
RADIUS IN YARDS *2,000*



CONDITIONS

ALTITUDE *25,000 FT*
SPEED *300 MPH*
WEAPONS *90-mm*
REMARKS *NONE*

AVERAGE INDEX NUMBER (from AAA Planning Factors Table) *39*

Figure 9. Effectiveness clock—unbalanced defense.

Section III. SIMPLE DEFENSE DESIGN

69. ASSUMED CONDITIONS

a. In establishing a simple defense, the following assumptions have been made:

(1) Speed of attack; from 200 to 400 miles per hour (use 300 mph).
(2) Altitude of attack; up to 30,000 feet (use 25,000 ft).
(3) Direction of attack; equally probable from any direction.
(4) No major terrain difficulties are present.
(5) Vulnerable area can be resolved into a circle.
(6) There is no substantial prevailing wind that can be determined in advance.
(7) There are no other air defense measures which would influence the design of this defense.

b. Should any of these conditions be materially changed, it would be necessary then to consider it as a special case or to obtain new planning factors.

70. PROCEDURE

a. Based upon the assumptions listed above, the general procedures for the establishment of a simple defense are as follows:

(1) Secure a suitable map containing the vulnerable area and showing the surrounding terrain.
(2) Resolve the vulnerable area into a circle

which approximately circumscribes the area.

(3) Place the bomb release line around the vulnerable area (this bomb release line will be obtained from an appropriate fire unit analyzer).

(4) Place through the center of the vulnerable area, the direction of attack lines for every 30° direction of attack line starting at 0°.

(5) Place the optimum gun ring (OGR) around the vulnerable area (this is obtained from appropriate planning factors table for any particular combination of fire units available and the size of the vulnerable area).

(6) Based upon a map reconnaissance, place fire units on or near the optimum gun ring and approximately equally spaced.

Note. It will not always be possible to stay exactly on the optimum gun ring but deviation therefrom should be held to a minimum and should still meet requirements of a suitable position area.

(7) Analyze the defense for each direction of attack line by use of the appropriate fire unit analyzer. Tabulate the results on the appropriate recording form.

(8) Plot the effectiveness clock based on the above analysis and check against the indicated average index value (this index value for the combination of fire units and size of the vulnerable area is obtained from planning factors table).

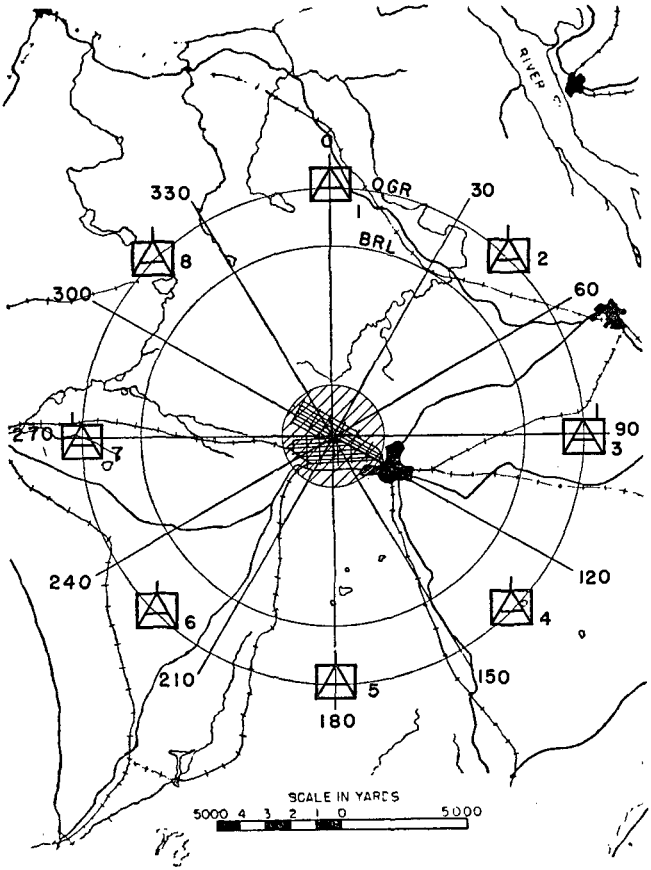


Figure 10. A completed simple defense.

(9) Make a ground reconnaissance to select suitable position areas as close as possible to those determined by the map reconnaissance.

(10) Based upon the actual position areas selected, reanalyze the defense and replot the effectiveness clock. If this analysis indicates that the defense is not adequately balanced, successive relocations of fire unit positions will be necessary until a satisfactory solution is reached.

b. Figure 10 is an example of a completed simple defense.

Section IV. MAJOR TERRAIN DIFFICULTIES

71. GENERAL

a. The general procedures for a simple defense design as outlined above, must be modified for certain special conditions as they occur in the field. For example, when major terrain difficulties (mountains, wooded areas, shore lines, cities, bodies of water to include rivers, lakes, swamps, and small islands) present themselves, the defense must be specially designed in order to obtain the necessary balance and if possible the indicated strength.

b. The assumptions made in paragraph 69*a* for a simple defense design hold true, except that major terrain difficulties are encountered.

72. PROCEDURES, MAJOR TERRAIN DIFFICULTIES

a. The general procedures for the establishment of a defense involving a major terrain difficulty are as follows:

(1) Secure a suitable map containing the vulnerable area and showing the surrounding terrain.

(2) Resolve the vulnerable area into a circle which approximately circumscribes the vulnerable area.

(3) Place the bomb release line around the vulnerable area (this bomb release line will be obtained from an appropriate fire unit analyzer).

(4) Place through the center of the vulnerable area, the direction of attack lines for each 30° direction of attack line starting at 0°.

(5) Place the optimum gun ring (OGR) around the vulnerable area (this is obtained from appropriate planning factors table for any particular combination of fire units available and the size of the vulnerable area).

(6) Place the fire unit analyzer in the proper position to analyze one of the direction of attack lines in the area in which the terrain difficulty exists.

(7) Based on a map reconnaissance and using the fire unit analyzer values as a guide, place sufficient fire units to obtain the total index value. Enter these values on the recording form.

Note. In selecting positions for fire units, two factors should be borne in mind: First, fire units should be spaced so as to result in as near equal spacing of all fire units in the defense as

possible. Second, fire units should be placed as near as possible to the optimum gun ring.

(8) Place the fire unit analyzer on either of the adjacent direction of attack lines. Read and enter the values on the recording form of the fire units already placed.

(9) Compare the total contribution of the readings in procedure 8 with the indicated average index number obtained in procedure 5. If the total contribution equals or exceeds the indicated average index number, no additional fire unit(s) is needed to defend against this direction of attack. If the total contribution is less than the indicated average index number, locate a fire unit or units so as to give a reading sufficient to make the total contribution for that direction of attack approximately equal to the indicated average index number.

Note. Where terrain difficulties present themselves, it may be impossible to obtain the exact value of the indicated average index number; however, the defense should be so designed as to obtain balance even though this may result in a reduction from the indicated index number in the AAA planning factors table. Every effort should be made to obtain the highest index numbers possible. Index numbers below 18 indicate a defense which is considered too weak to obtain sufficient destruction of hostile aircraft. However such defenses may be necessary and valuable for morale purposes.

(10) Continue the processes outlined in (8) and (9) above, until all courses have

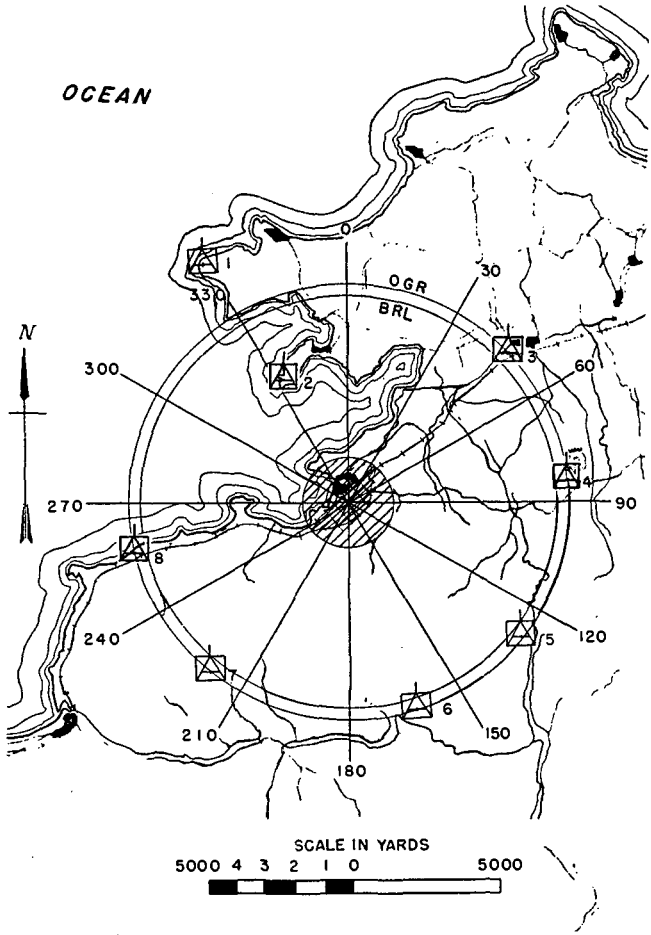


Figure 11. Completed defense, with a major terrain difficulty.

been satisfactorily completed. Total the columns on the recording form.

(11) Plot the effectiveness clock.

(12) Make a ground reconnaissance to select suitable position areas as close as possible to those determined in the map reconnaissance.

(13) Based on the actual position areas selected reanalyze the defense and replot the effectiveness clock. If the analysis indicates that the defense is not adequately balanced, successive relocations of fire unit positions will be necessary until a satisfactory solution has been obtained.

b. Figure 11 is an example of a completed defense with a major terrain difficulty.

Section V. SPECIAL CONSIDERATIONS

73. EFFECT OF ATOMIC ATTACK ON THE SIZE OF THE VULNERABLE AREA

Because of the widespread effect of an atomic explosion, the size of the vulnerable area must be increased if the mission includes defense against atomic attack.

a. In considering expansion of this area over land, three major factors must be considered:

(1) Location of critical installations within the vulnerable area.

(2) Type and nature of these critical installations and the surrounding terrain.

(3) The distance from ground zero at which these critical installations will suffer

severe damage from an atomic explosion.

b. Vulnerable areas located adjacent to large bodies of water may be neutralized effectively by an underwater explosion of an atomic missile delivered by aircraft, submarine or surface vessel. Under this threat the water area adjacent to the vulnerable area must be considered as part of the vulnerable area and be included in the defense design. To determine the size of the vulnerable area to be protected, Department of Defense pamphlet, "The Effects of Atomic Weapons," should be consulted. In order to protect this area effectively, floating fire units such as light naval vessels may be required. These floating units must be integrated in the defense.

c. This expansion of the vulnerable area will require additional matériel to provide the same level of defense. Therefore, the decision to expand the defense rests with the authority responsible for the allocation of matériel.

74. SPECIAL CONDITIONS OF ATTACK

After a medium or heavy AAA defense has been established it may be found that the enemy will channelize his attack as to altitude and/or speed, and/or direction. When such special conditions of attack exist, as opposed to the varying conditions for which the defense was designed, the AAA defense commander should reanalyze the defense based on this additional information.

a. When the altitude of attack is known, the fire

unit analyzer, basic or special, that approximates the known altitude is used for this reanalysis together with the appropriate BRL from this analyzer. When the speed of attack only is known, the appropriate BRL, taken from the basic fire unit analyzer, is used for this reanalysis. Based upon this reanalysis, a command decision must be made as to the advisability of redesigning the defense in the light of these known conditions of attack. The fact that the special conditions of attack are of the enemy's own choosing or are dictated by the terrain or his own limitations should be considered in making such decisions.

b. When the enemy channelizes his attack as to direction, again a decision must be made by the AAA defense commander. This decision concerns the advisability of strengthening the defense in the favored or forced direction of attack. As no part of a defense can be strengthened without a weakening of some other part, unless additional matériel is allocated, care must be taken that no part of the defense is weakened below the minimum. The enemy may analyze the defense or receive information which would lead him to attack in the weakened sector.

75. NONCIRCULAR VULNERABLE AREAS

a. Generally most AAA defended areas can be resolved into circles not more than 5,000 yards in diameter. However, vulnerable areas will occasionally be encountered which cannot be economically resolved into a circle because of their size and shape. These areas are called noncircular

vulnerable areas. When planning the defense of such areas, the following procedures will apply.

(1) For long narrow vulnerable areas (over 5,000 yards in length and less than 1,000 yards in width) the bomb release line and optimum gun ring should be placed around the vulnerable area as an oval (race track) as shown in figure 12. The BRL distance is measured from the edge of the vulnerable area. The optimum gun ring is measured out a distance of 3,000 yards from the center of the vulnerable area and along its entire length as indicated in figure 12.

(2) For other noncircular vulnerable areas the BRL is circumscribed by measuring the BRL distance outward from all edges of the vulnerable area. The optimum gun ring must be determined by analyzing a series of gun rings until the highest index number is obtained, consistent with the basic considerations in the disposition of fire units prescribed in paragraph 58. It is suggested that the BRL be used as a starting point.

b. The analysis of defense for noncircular vulnerable areas must, of necessity, be adapted to the particular shape of the vulnerable area. The analysis of twelve direction of attack lines, 30° apart and converging on a center point, as explained in prior sections, will not be appropriate in most cases. As principles in analyzing these defenses, the following will generally apply:

Figure 12. Bomb release line and optimum gun ring for long narrow vulnerable area.

(1) The vulnerable area will have two or more ends or corners that will be resolved into parts of circles. The defense of each of these ends or corners will be analyzed as before for direction of attack lines 30° apart around the portion that is circular and converging on the center of each circle.

(2) The portion of the defense between the end or corner circles will be analyzed for direction of attack lines perpendicular to the edge of the vulnerable area and spaced about 2,000 to 4,000 yards apart. Figure 13 shows the direction of attack lines chosen to analyze a long, narrow vulnerable area.

c. To portray such an analysis geographically, the effectiveness clock must be specially drawn to such a scale as to indicate the shape of the vulnerable area and permit plotting the index number of each direction of attack line chosen. Figure 14 shows an effectiveness clock that would be appropriate for the long, narrow vulnerable area in Figure 12.

76. MULTIPLE VULNERABLE AREAS

a. When two or more vulnerable areas located in the same vicinity are to be defended, greater defense strength is often obtained by designing integrated or coordinated defenses. No special rules can be established for such defenses since the size of and the distance between the vulnerable areas will dictate the method used. In general the

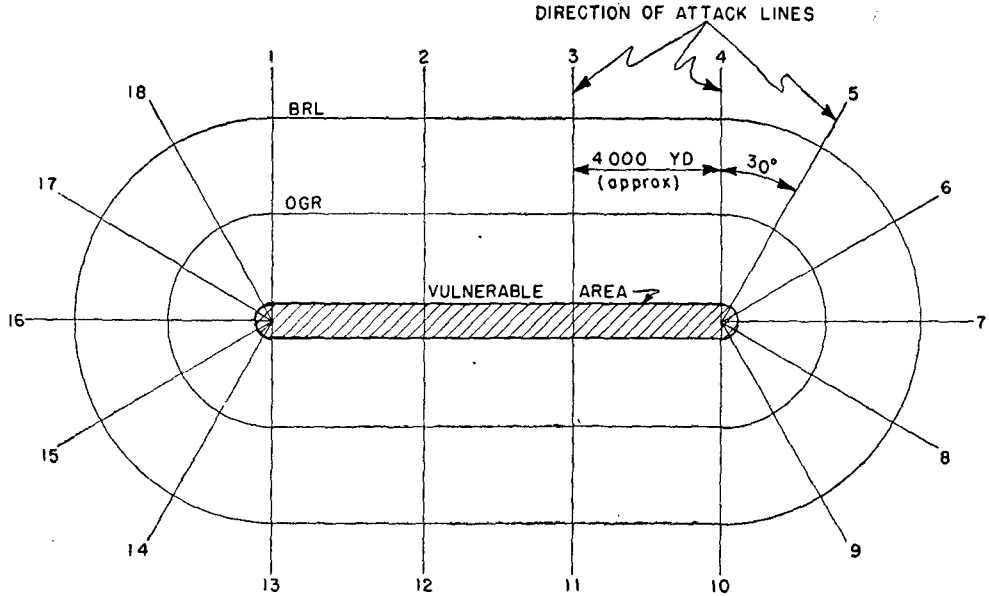


Figure 13. Direction of attack lines for long, narrow vulnerable area.

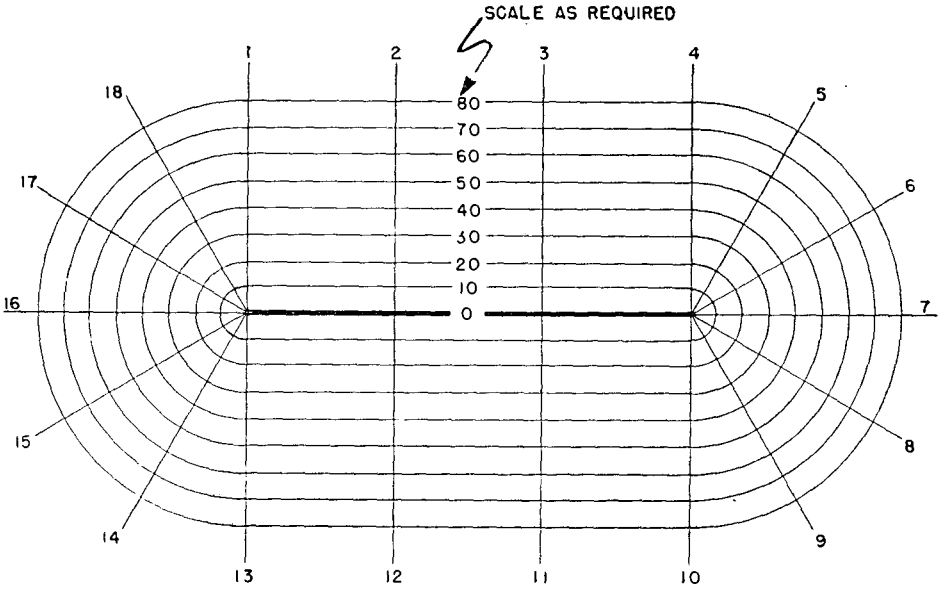


Figure 14. Effectiveness clock for long, narrow vulnerable area.

optimum gun rings for these vulnerable areas may be one of the following:

(1) Circular.

(2) Oval (race track) (fig. 15).

(3) Two or more intersecting circles or modified oval (fig. 16).

b. To establish the best defense of multiple vulnerable areas with the matériel available, a series of gun rings for each of the three optimum gun ring shapes listed above should be analyzed. As a guide, the optimum gun ring distance from the AAA planning factors table should be selected. In selecting the shape of the optimum gun ring with which to start, the following general rules can be considered:

(1) When two vulnerable points are located within 5,000 yards of each other, they should be defended with an oval optimum gun ring. When the distance between vulnerable points is greater than 5,000 yards the defense may be established using only one optimum gun ring or two coordinated optimum gun rings, depending on the distance between vulnerable points. If one optimum gun ring can be used it should be an oval or modified oval (fig. 15). If the distance between the vulnerable points is so great as to necessitate separate optimum gun rings then the defense should be designed as two separate and coordinated defenses.

(2) When two vulnerable areas 1,000 yards in radius are located within 10,000 yards

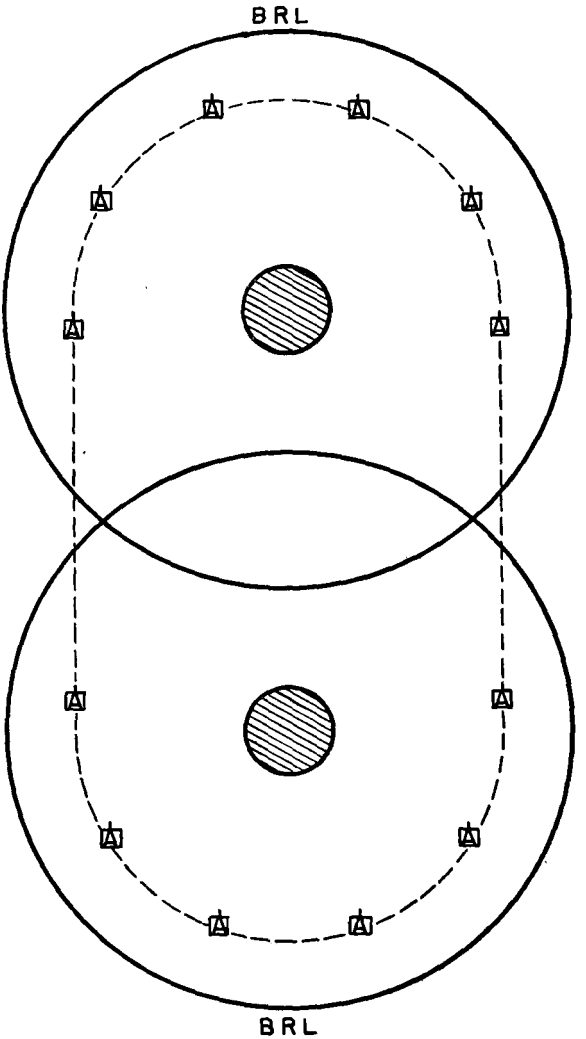


Figure 15. Multiple vulnerable areas—oval (race track), optimum gun ring.

center to center, they should be defended with an oval optimum gun ring, such as shown in (fig. 16). When the distance between centers exceeds 10,000 yards, separate coordinated defenses should be established.

(3) When two vulnerable areas 2,000 yards in radius are located within 7,000 yards center to center, they should be defended with an oval optimum gun ring. When the distance between centers exceeds 7,000 yards the vulnerable areas may be defended with a modified oval optimum gun ring (fig. 16) or separate coordinated defenses.

c. When designing defenses of two or more vulnerable areas that differ appreciably in size, the position of the optimum gun ring, as well as its shape, must be determined by analysis. A series of gun rings should be analyzed until the highest index number is obtained, consistent with the basic considerations in the disposition of fire units prescribed in paragraph 58. It is suggested that the BRL be used as a starting point.

77. COMPOSITE DEFENSE

a. General. A composite AAA defense is defined as an AAA defense that employs two or more types of fire units which may include medium and heavy AAA guns integrated into a single defense. For example, a defense composed of fire units of both 90-mm and 120-mm guns would be considered

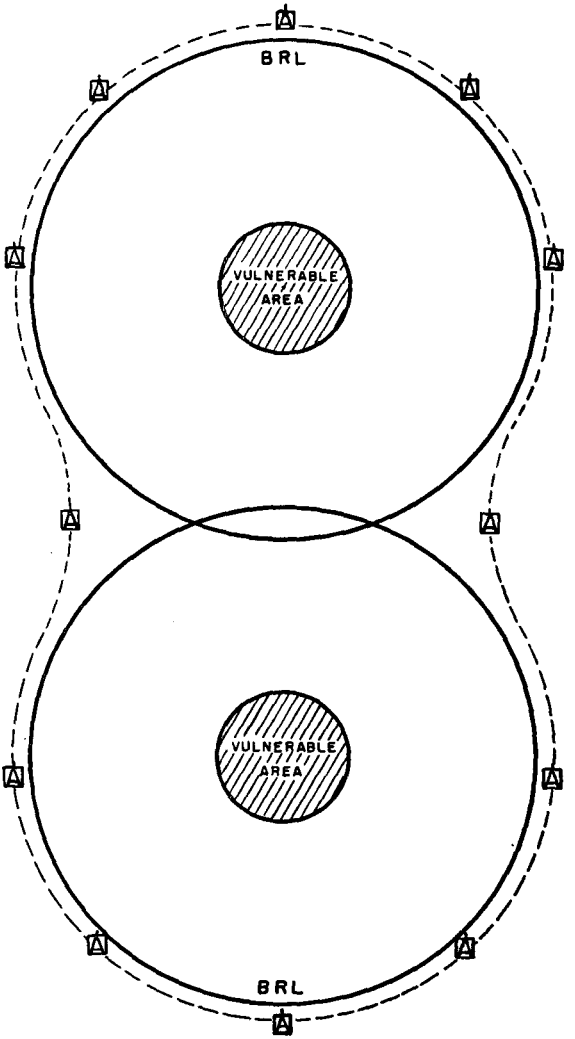


Figure 16. Modified oval, optimum gun ring.

a composite defense. Composite defenses are established:

(1) When dictated by the availability of matériel.

(2) When guns of longer range are employed with those of lesser range to overcome gaps or limitations caused by major terrain difficulties. For instance, for a target on a seacoast, 120-mm guns could be sited on the seaward side of the vulnerable area in order to permit effective fire on targets approaching from that direction.

b. Simple Composite Defense. A simple composite defense is designed in the same manner as a simple defense, except for the selection of the optimum gun ring. An examination of the AAA planning factors table will indicate that the values of optimum gun rings for identical conditions vary for 90-mm and 120-mm guns. Therefore, the fire units probably will not be placed on a single gun ring. In selecting the optimum gun ring for each type of gun used, enter the planning factors table with the size of the vulnerable area and the total number of all fire units available. Thus, if a vulnerable area is 3,000 yards in radius and 8 batteries of 90-mm and 8 batteries of 120-mm guns are available, enter the planning factors table on a 3,000 yard radius vulnerable area line and read the 90-mm optimum gun ring and the 120-mm optimum gun ring under the 16-battery column. The 90-mm optimum gun ring for this

example is 12,000 yards and the 120-mm optimum gun ring is 8,000 yards (where the table indicates two optimum gun rings for the 90-mm gun, the larger optimum gun ring value should be utilized in establishing a composite defense). Having selected the proper optimum gun ring, fire units are evenly distributed on their respective optimum gun rings with the 90-mm and 120-mm batteries located alternately as shown in figure 17. In making an analysis of such a defense, the appropriate fire unit analyzer for each of the weapons must be utilized to determine the contribution of those fire units to the total defense. The index numbers for the 90-mm and 120-mm fire unit analyzers have been so selected that they may be added together to determine the total effectiveness of the defense when considering any particular direction of attack line.

c. Composite Defense With Major Terrain Difficulties. In the case of a major terrain difficulty, the defense is established by the same method as prescribed in paragraph 72*b*. However, the major portion of the fire units of greater range should be sited in the area where their greater range would achieve a balanced defense. Usually they would be sited in that sector where the terrain difficulties exist. The spacing of these fire units will not necessarily be uniform nor will they alternate with fire units of lesser range. The remaining weapons will be placed as near to their respective optimum gun rings as is possible to cover the remaining directions of attack. Again, the objective sought is a balanced defense with the high-

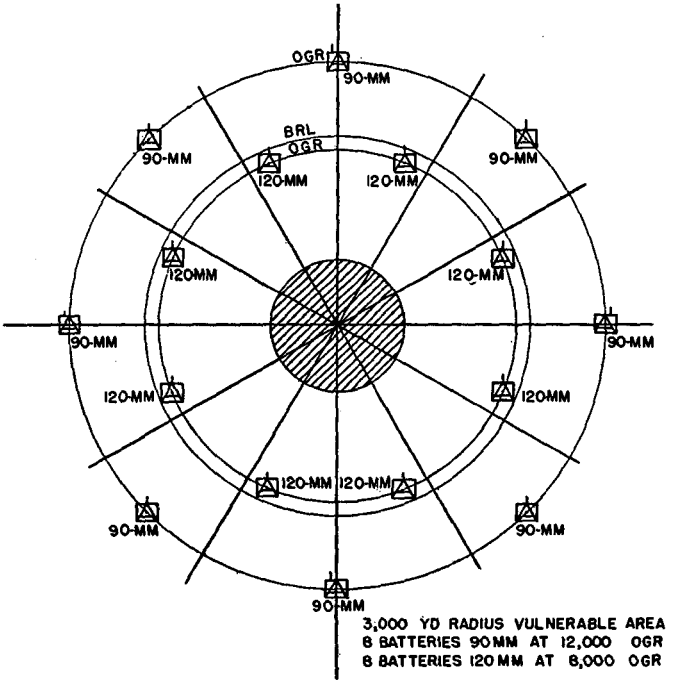


Figure 17. A simple composite defense.

est index number possible using the material available. Figure 18 shows a composite defense with major terrain difficulties.

d. Composite defenses of noncircular vulnerable areas and multiple vulnerable areas are designed as outlined in paragraphs 83 and 84, with the exception that separate optimum gun rings may be used for each type of gun. It should be noted that in those cases where the optimum gun ring must be found by the analysis of a series of

gun rings, this may be done separately for each type of gun used or one ring may be used for both types.

78. AIR-TO-SURFACE AND SURFACE-TO-SURFACE MISSILES AS TARGETS

a. By the use of glide bombs with wings, vanes, and guidance systems, bombardment aircraft can

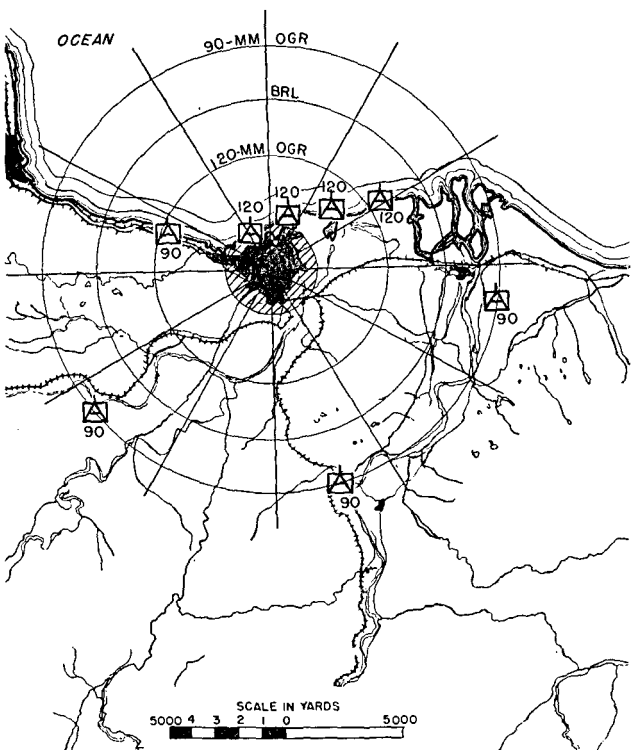


Figure 18. A composite defense with a major terrain difficulty.

extend the bomb release line to as much as 20 miles from the vulnerable area. It is uneconomical to provide special antiaircraft defenses for this type of attack. If the parent aircraft is not required to fly a rectilinear course when dropping a bomb, then the bomb itself should be taken as the target. If, however, the parent aircraft is required to fly a rectilinear course in order to guide the bomb to the target, then, as a general rule, the parent aircraft should be selected as the target for the AAA defense since it usually presents a more profitable target from the defender's standpoint.

b. The capabilities of antiaircraft matériel now in the hands of troops limit the engagement of guided missiles to those that are transonic or less. As long as the enemy can attack a target with both conventional bombs and missiles with transonic speed or less, an all-around defense must be provided. This defense should be designed according to the principles already set forth.

c. If the enemy can attack only with missiles and these attacks are canalized into one or more directions, a defense design can be adjusted to place all or the major portion of the fire units in the sector of attack.

79. WIND

When a prevailing wind in excess of 50 mph can be predicted at an altitude at which an attack can be expected, the defense should be shifted into the wind, and fire units should be increased on

the windward side. It is better to use the conventional design unless a strong, constant-velocity wind of several days duration can be definitely predicted.

Section VI. FIRE DIRECTION

80. GENERAL

As an aid to fire direction and the selection of targets, the AAA defense commander should establish sectors of fire. Each fire unit should be assigned to a primary sector of fire and a contingent sector of fire. The primary sector of fire should be of such a size that all fire units will be responsible for approximately equal primary sectors. In all cases it is normal to overlap adjacent assigned sectors. The overlap should be about 10° to 15°. The contingent sector of any battery includes the remainder of its field of fire.

81. MULTIPLE TARGETS

If only one target appears in the primary sector of a fire unit, it should be engaged as long as possible. If more than one target appears in the primary sector, the fire unit commander should attempt to engage effectively the maximum number of targets within the sector. If no target appears within the primary sector, as many targets as can be effectively fired on in the contingent sector should be engaged.

82. RULES FOR SELECTION OF TARGETS

a. In order to engage the maximum number of

targets, it follows that many of them will not be engaged for a maximum period of time. The following general considerations determine when to start and when to break off engagement:

(1) With respect to the fire unit, approaching targets are more profitable to engage than receding targets, taking into consideration the slant range.

(2) The best portion of an incoming course starts at some point less than maximum range (approximately 25 seconds time of flight), and continues up to about midpoint.

(3) Transfer time must be considered. This usually amounts to 20 seconds (slewing, pick-up, and settling time) plus the time of flight to the new target.

(4) Every effort should be made to have each target engaged up to the bomb release line by at least one fire unit.

b. The AAA defense commander should establish rules for the selection of targets within the primary and contingent sectors for the various fire units.

Section VII. INCIDENTAL PROTECTION

83. GENERAL

The results of the analysis of a defense, as presented by means of the recording form and effectiveness clock (par. 68), portrays the effectiveness of a defense within the limits of the vulner-

able area. In many cases it may be desirable to determine the degree of protection offered other areas within the vicinity of the defended area. This incidental protection can be determined by making an expanded analysis of the vulnerable area. The principles involved in determining incidental protection are set forth in the example below.

84. STEPS IN ANALYSIS

The following are the steps in analyzing incidental protection of an AA defense, using as an example 8 batteries of 90-mm guns to defend an area 2,000 yards in radius. Assume that the defense has been established (fig. 10) and analyzed with the results tabulated on the recording form (fig. 19).

a. Step 1. Place on the map (fig. 10) at the intersection of the direction of attack line and the edge of the vulnerable area, the total index number for each attack line as shown on the recording form (fig. 19).

Note. The total index numbers, as shown on the recording form, indicate the relative strengths of the defense for only 12 direction of attack lines. If a more detailed analysis is desired, additional direction of attack lines are drawn through those fire unit positions which are not already located on a direction of attack line and through other points as desired. The index contributions for each attack line are tabulated and totaled on the recording form and placed on the map as indicated in *a* above. For purposes of clarity only 12 direction of attack lines are used in this example.

b. Step 2. Determine the maximum horizontal

~~RESTRICTED~~
(when filled in)

DATE 1 SEPT 1950

RECORDING FORM

VULNERABLE AREA SAMPLE RADIUS IN YARDS 2,000

AVERAGE INDEX NUMBER (from AAA Planning Factors Table) 39

FIRE UNIT and CALIBER	DIRECTION OF ATTACK (degrees)											
	0	30	60	90	120	150	180	210	240	270	300	330
(90)	20.0	15.5	1.4								1.4	15.5
2	7.0	25.5	25.5	7.0								
3		1.4	15.5	20.0	15.5	1.4						
4				7.0	25.5	25.5	7.0					
5					1.4	15.5	20.0	15.5	1.4			
6							7.0	25.5	25.5	7.0		
7								1.4	15.5	20.0	15.5	1.4
8	7.0									7.0	25.5	25.5
9												
10												
11												
12												
13												
14												
15												
16												
TOTAL INDEX NO.	34.0	42.4	42.4	34.0	42.4	42.4	34.0	42.4	42.4	34.0	42.4	42.4

RESTRICTED
(when filled in)

Figure 19. Completed recording form.

range of the fire unit from the fire unit analyzer (basic) fig. 6. This is done by measuring the distance between the center cross and the outer contour line. In this example the distance is 9,300 yards. Using this distance as a radius and the center of the fire unit position area as the center, describe intersecting range arcs around fire unit position areas (fig. 20).

c. Step 3. Refer to the fire unit analyzer (basic) fig. 6 and determine the bomb release line distance (use 300 mph). This distance is found to be 5,500 yards. Measure this distance, in the direction of the center of the vulnerable area, at the following points:

(1) At the intersection of two horizontal range arcs.

(2) At the center of each horizontal range arc.

Mark each point as "0" on the map (fig. 20).

Note. This establishes a point on the ground which is the zero index number.

d. Step 4. Increase the radius of the first (original) vulnerable area by 2,000 yards. This will create a new vulnerable area, 4,000 yards in radius. Circumscribe the second (expanded) vulnerable area on the map with a broken line, using the center of the first vulnerable area as the pivotal point (fig. 21).

e. Step 5. Refer to the fire unit analyzer (basic) fig. 6 and determine the bomb release line distance (use 300 mph) for this second vulnerable area. This distance is the same as determined in *c*

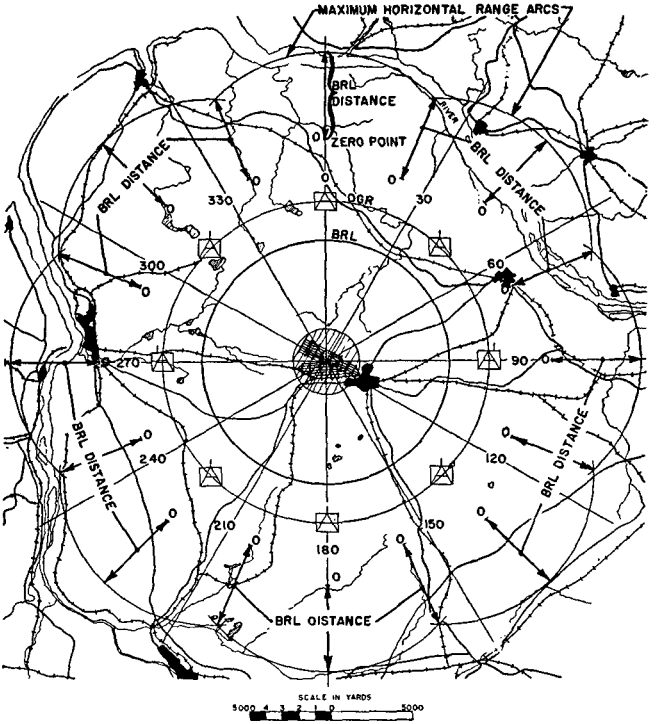


Figure 20. Established points of "0" effectiveness.

above, 5,500 yards. Measure this distance outward from the edge of the second vulnerable area and draw in the second bomb release line with a broken line. (fig. 21).

f. Step 6. Analyze the defense of the second vulnerable area for each direction of attack line by using the fire unit analyzer (basic). To analyze each attack line, place the center cross over the intersection of the second bomb release line and

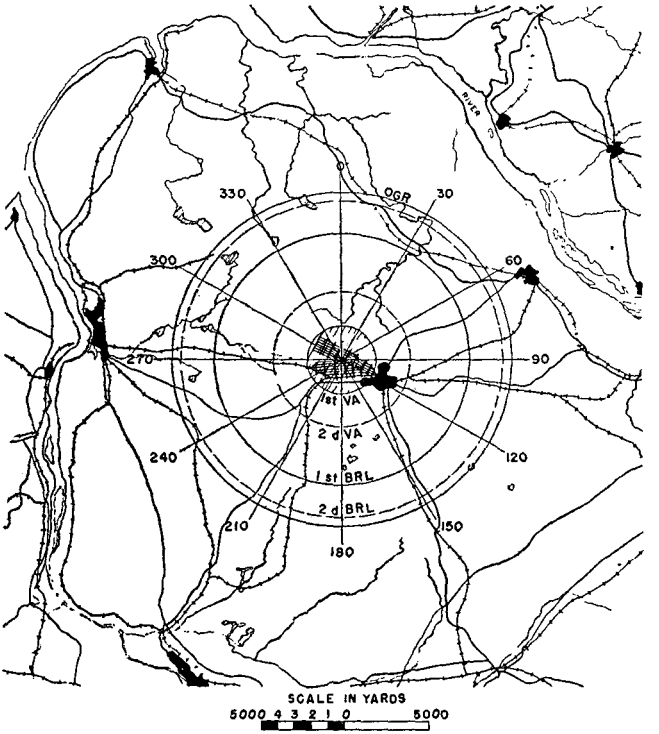


Figure 21. Second vulnerable area and bomb release line.

direction of attack line. The direction of flight arrow should point toward the vulnerable area. Tabulate and total index contributions on the recording form for each direction of attack line.

g. Step 7. Record on the map the total index number for each direction of attack line at the appropriate intersection of the outer edge of the second vulnerable area and direction of attack line (fig. 22).

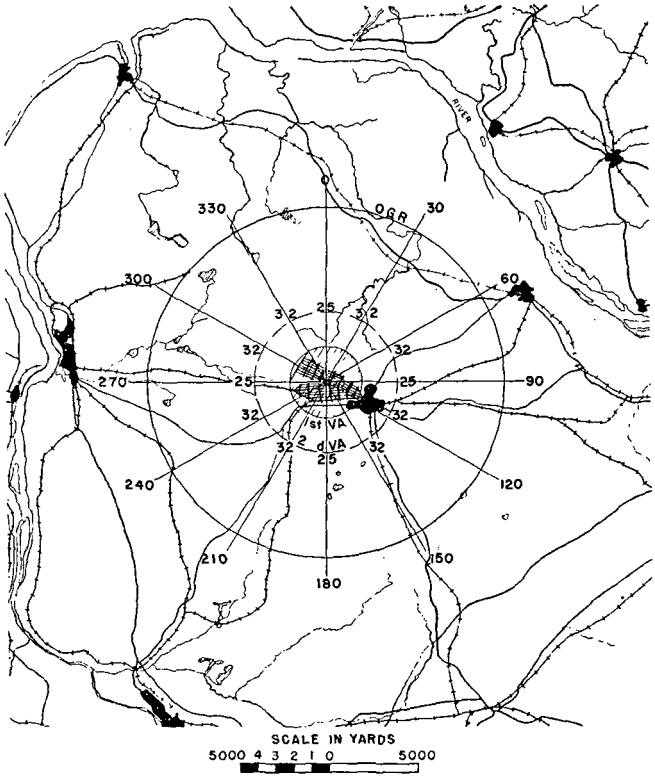


Figure 22. Index numbers recorded on map for second vulnerable area.

h. Step 8. Increase the radius of the first (original) vulnerable area by 4,000 yards. This creates a third vulnerable area 6,000 yards in radius. Circumscribe the third vulnerable area on the map with a broken line, using the center of the first vulnerable area as the pivotal point. (fig. 23).

i. Step 9. Refer to the fire unit analyzer (basic)

fig. 6 and determine the bomb release line distance (use 300 mph) for the third vulnerable area. This distance is the same as determined in *c* above, 5,500 yards. Measure this distance outward from the edge of the third vulnerable area and draw in the third bomb release line with a broken line. (fig. 23).

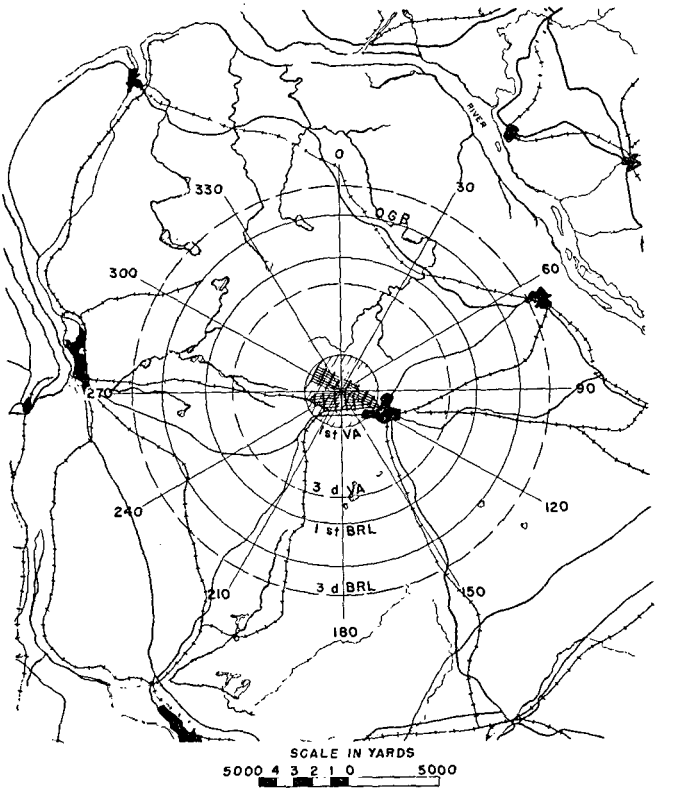


Figure 23. Third vulnerable area and bomb release line.

j. Step 10. Analyze the defense of the third vulnerable area. See *f* above for analysis procedure. Tabulate and total index contributions on the recording form for each attack line.

k. Step 11. Record on the map, the total index number for each direction of attack line at the appropriate intersection of the outer edge of the third vulnerable area and direction of attack line (fig. 24).

l. Step 12. Make an overlay of the map showing the original vulnerable area, the direction of attack lines, and the index numbers as established in *a–k* above. Connect all zero index points with a smooth and continuous curve. Interpolate on the overlay between the zero contour line and other index values to establish points of minimum effectiveness (index 18) for each direction of attack line. Mark these points 18.

Note. All areas and installations between index number 0 and 18 are receiving less than minimum protection. Areas inside index 18 are receiving more than the minimum protection.

m. Step 13. Connect the minimum index points (18) with a smooth and continuous curve (fig. 25).

Note. If it is desired to portray graphically, the incidental protection for the area from the outer edge of the original vulnerable area to the zero index line, this may be done by means of a color code. To prepare this portrayal, draw contour lines, joining points of equal index numbers, at selected intervals, and establish a color code for the intervals falling within the zone of major protection (18 index line and higher). For example, draw contour lines for numbers 18, 23, 28, and 33: The area between 18 and 23 is shaded green; the area between 23 and 28 red; and

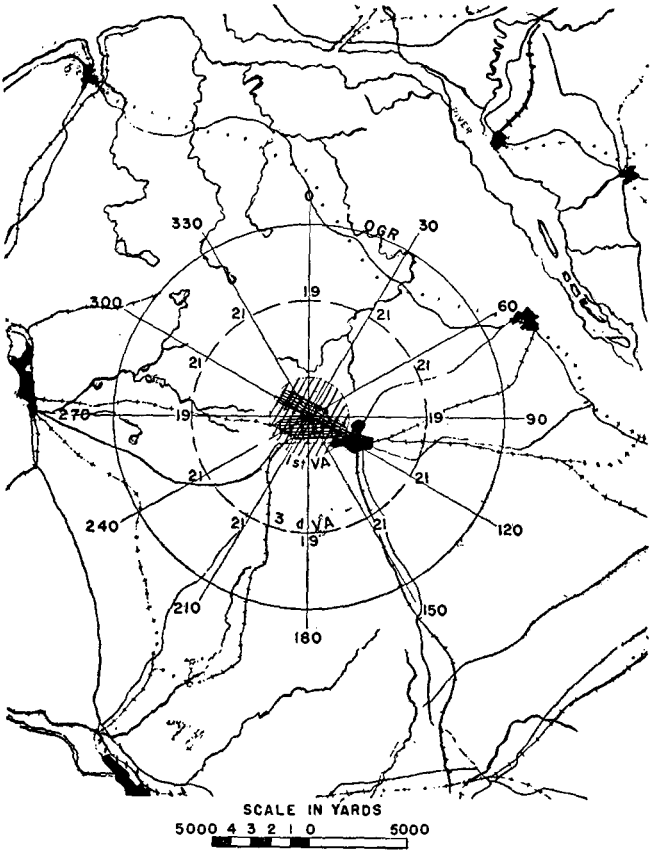


Figure 24. Index numbers recorded on map for third vulnerable area.

the area between 28 and 33 blue. If the index number of a specific point is desired, it may be found by straight line interpolation between contour lines.

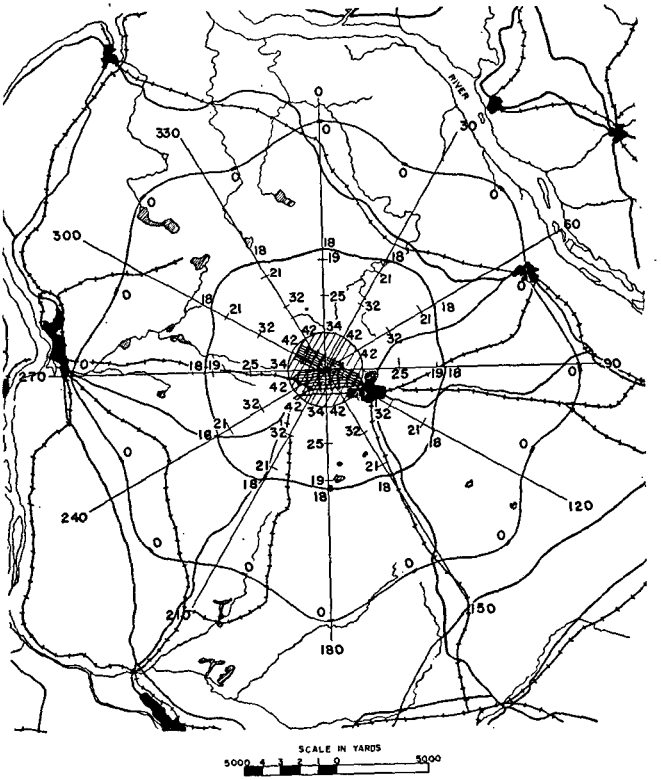


Figure 25. Established minimum and zero contour lines.

85. SPECIAL CONSIDERATIONS

The above example is intended to illustrate the principles involved in evaluating incidental protection of an area. The number and size of expansions of the vulnerable area is not limited to two and 2,000 yards as used in the example above.

Expansions may be increased or decreased dependent upon the size, shape and nature of area defended and upon the extent of analysis desired. If the original defense of a vulnerable area entailed any special considerations, such as special conditions of attack which require the use of a special fire unit analyzer and bomb release line, the determination of incidental protection will require the use of the same special fire unit analyzer and bomb release line and will reflect the incidental protection only for those special conditions of attack.

CHAPTER 9

DESIGN OF LIGHT ANTIAIRCRAFT ARTILLERY DEFENSES

Section I. INTRODUCTION

86. GENERAL

The following discussion of light AAA employment presents the principles involved in designing light AAA defenses. Normally, in establishing light AAA defenses, commanders are presented with the problem of how best to use available matériel considering the conditions under which it is to be employed. A planning factors table (table III) has been provided as a guide for the utilization of light AAA matériel. The table sets forth the minimum amount of light AAA considered adequate to provide a minimum defense and the suggested disposition of fire units for various sizes of circular vulnerable areas without regard to the nature of the area. However, each defense must be hand-tailored, taking into account the situation that confronts the commander. When less than the minimum amounts of light AAA are employed for the defense of a vulnerable area, the defense is inadequate. As a general rule, better defenses and a saving of matériel can be effected if the defense can be integrated with adjacent defenses to form an over-all area defense.

87. FACTORS AFFECTING THE AIR DEFENSE MISSION

There are five major factors which affect the accomplishment of the air defense mission of light AAA guns with the means allocated. These factors are discussed in paragraph 57.

a. Enemy tactics, techniques, and capabilities.

b. Capabilities and limitations of AAA weapons.

c. Vulnerable area size, shape, and nature.

d. Weather and terrain.

e. Other air defense means.

88. CONSIDERATIONS OF ENEMY CAPABILITIES

Prior to the establishment of a light AAA defense it is necessary to consider the capabilities, tactics, and techniques of the enemy air force. Normally, defenses should be designed which will meet all types of attack which the enemy is capable of employing. However, if intelligence sources reveal that the enemy must limit his attacks as to altitude, speed, direction, type of attack, or type of ammunition, a special defense should be designed to meet the anticipated conditions of attack in the most effective manner. Constant interpretation and evaluation of the enemy's capabilities, tactics, and techniques must be made to determine what shifting of the defense may be necessary to meet changes. Provisions must be made for occupation of alternate positions to deceive the enemy.

89. CAPABILITIES AND LIMITATIONS OF LIGHT AAA WEAPONS (40-MM, CALIBER .50 MACHINE-GUN)

Light AAA weapons should be located approximately 300–600 yards (not to exceed 1,000 yards) apart, and the dead areas of fire units covered by coordinating the dead areas of all the fire units in the defense. The 40-mm guns, with longer ranges, larger projectiles, but slower tracking rates as compared to the caliber .50 machine-gun (quad mount), are sited so as to minimize the effects of their limitations and exploit to the maximum their capabilities. Normally, some 40-mm fire units will be located in and around the vulnerable area and others 1,250 yards outward from the outer edge of the vulnerable area. If there are certain well defined routes of approach, and weapons in excess of the minimum requirements are available, these excess fire units should be placed so as to cover these routes of approach. This will extend the depth and fire power of the defense along these routes. The caliber .50 machine-guns (quad mount) with faster tracking rates but relatively short range, must be placed at a greater distance from the vulnerable area if they are to engage the enemy prior to his reaching the bomb release line. Defenses are designed to counter all types of attack; but, because of range limitations of light AAA weapons, defenses are not designed for low level horizontal attacks higher than 2,000 feet above the ground elevation.

90. BASIC CONSIDERATIONS IN THE DISPOSITION OF FIRE UNITS

In the disposition of light AAA fire units, the following six basic considerations, listed in their general order of importance, must be kept in mind. These considerations are discussed in paragraph 58.

a. Balanced defense (in those cases where the enemy may attack equally well from all directions).

b. Maximum attrition rate.

c. Continuity of engagement.

d. Engagement of targets.

e. Routes of approach.

f. Selection of position.

Section II. TOOLS FOR ANALYSIS AND DESIGN OF LIGHT AAA DEFENSES

91. GENERAL

In the analysis and design of light AAA defenses, certain tools have been provided to enable commanders to establish and analyze defenses. With the tools, the matériel can be placed where it can obtain maximum effectiveness against specific conditions of attack.

92. PLANNING FACTORS TABLE FOR LIGHT AAA

One of the tools used in planning a light AAA defense is the planning factors table for light

AAA (table III). This table is based on the size of the vulnerable area and the matériel required to provide a minimum defense. It will furnish the user with number, type, and suggested location of fire units for circular vulnerable areas. The table is to be used as a guide in planning a defense, since each defense must be hand-tailored to fit the local conditions.

93. DEFENSE ANALYZER

Another of these tools is the light AAA defense analyzer. This is a graphical overlay printed on a transparent material that enables the user to analyze and design light AAA defenses. The two categories of light AAA analyzers are:

a. Light AAA defense analyzer M1, 40-mm, designed to measure comparative effectiveness of a 40-mm fire unit with respect to a given direction of attack (fig. 26).

b. Light AAA defense analyzer M1, caliber .50 machine-gun (quad mount), designed to measure the comparative effectiveness of a caliber .50 machine-gun fire unit with respect to a given direction of attack (fig. 27).

94. PRESENTING RESULTS

For convenience in presenting results of the analysis of a defense, two forms, the recording form and the effectiveness clock, are provided.

a. Recording Form. The index contribution of each fire unit (40-mm and caliber .50 machine-gun) in the defense, for each direction of attack

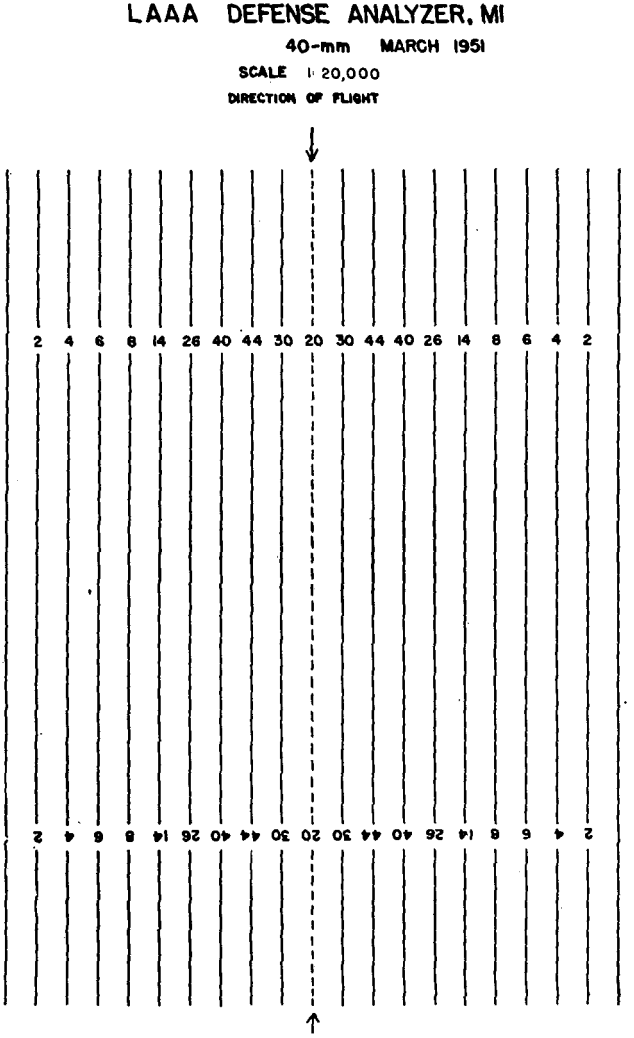


Figure 26. Light AAA defense analyzer M1, 40-mm.

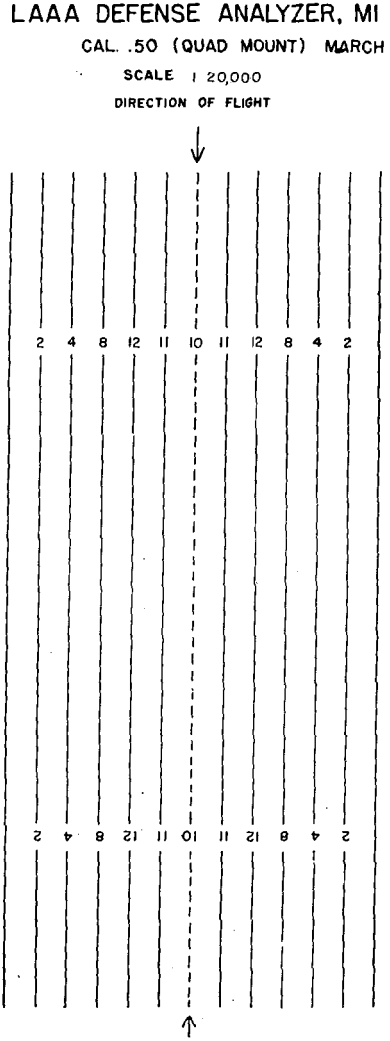


Figure 27. Light AAA defense analyzer M1, caliber .50 machine gun (quad mount).

DATE APRIL 1951

RECORDING FORM

VULNERABLE AREA SAMPLE RADIUS IN YARDS _____

AVERAGE INDEX NUMBER ~~(from AAA Planning Factors Table)~~ 237

FIRE UNIT and CALIBER	DIRECTION OF ATTACK (degrees)											
	0 180	20 200	40 220	60 240	80 260	100 280	120 300	140 320	160 340	A	B	C
1 40-MM	28	29	36	42	44	24	38	42	33	40	23	44
2 "	25	35	41	43	40	43	42	34	24	29	24	38
3 "	18	22	12	1	—	—	—	—	2	—	—	25
4 "	43	43	40	32	25	25	32	39	43	41	25	28
5 "	25	26	36	43	30	23	40	41	35	40	22	43
6 "	28	43	12	5	3	2	3	7	29	7	—	44
7 "	3	5	8	30	28	43	14	6	3	42	11	3
8 "	43	13	5	3	2	31	7	25	28	2	10	5
9 CAL .50	12	3	—	—	—	—	2	9	10	—	4	—
10 "	—	—	—	—	—	5	11	11	2	7	10	—
11 "	6	12	10	11	4	2	1	1	3	6	—	10
12 "	1	1	3	9	11	11	8	3	1	11	4	—
13 "	1	—	—	—	—	—	4	11	10	—	7	—
14 "	3	5	8	12	10	11	10	6	4	5	10	11
15 "	10	12	11	10	11	12	9	8	8	3	11	10
16 "	11	11	11	7	5	4	5	8	12	1	10	9
TOTAL INDEX NO.	257	260	233	248	213	236	226	251	247	234	171	270

Figure 28. Recording form.

line, is determined and tabulated on the recording form. Each column is then totaled to obtain the total contribution of the fire units for each direction of attack line. The number of direction of attack lines which might be considered is not limited by those shown on the recording form (fig. 28).

b. Effectiveness Clock. The defense analysis re-

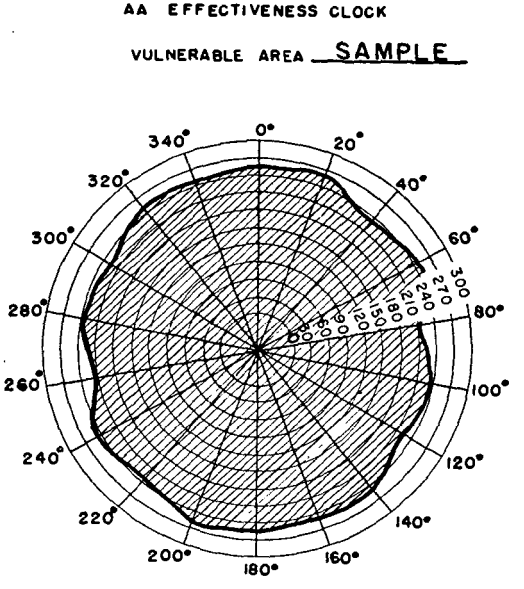


Figure 29. Effectiveness clock.

sults are presented graphically by means of a polar-coordinate chart called the effectiveness clock, figure 29. The clock for circular vulnerable areas is graduated in angular increments corresponding to the direction of attack lines and radially in equally spaced concentric circles. This permits the user to establish a scale in index numbers so that the maximum number falls somewhere near the outer circle. Having chosen an appropriate scale, the user plots the total index number for each direction of attack line as shown on the recording form and joins these points with a smooth curve. For vividness of presentation, the area enclosed in this curve should be shaded or crosshatched.

Section III. DEFENSE OF A VULNERABLE AREA

95. ASSUMED CONDITIONS

a. In establishing a light AAA defense of a circular vulnerable area the following assumptions have been made:

(1) Speed of attack—From 200 to 600 miles per hour.

(2) Type of attack—Dive, minimum altitude, low-level horizontal.

(3) Direction of attack—Equally probable from any direction (no specific avenues of approach indicated).

(4) No major terrain difficulties are present.

(5) There are no other air defense measures

which would influence the designing of the defense.

b. Should any of these conditions be materially changed it would be necessary to design a special defense based upon the existing conditions.

96. PROCEDURES

Based upon the assumptions listed in paragraph 95, the general procedures for the defense of a circular vulnerable area are as follows:

a. Plot the vulnerable area on a suitable map or overlay and define it by drawing a solid line around the installation(s) to be defended.

b. Refer to the planning factors table and determine the minimum number of batteries required to defend the area and the suggested disposition of fire units. If the matériel available does not meet the minimum requirements for the defense, an adequate defense cannot be established.

c. Place 40-mm and caliber .50 machine-gun fire units in and around the vulnerable area spaced 300–600 yards apart. For the number and types of fire units, see column 4, planning factors table, (table III).

Note. If the vulnerable area contains a number of more vital installations, 40-mm fire units are placed around these installations, 300–600 yards apart rather than being approximately equally distributed throughout the area. Some caliber .50 machine-gun fire units are placed between the more vital installations so as to insure continuity of fire throughout the area.

d. Place caliber .50 machine-gun fire units around the vulnerable area approximately 500

yards from the outer edge of the area. Coordinate the siting of these units with fire units already placed. For the number of fire units see column 5, planning factors table.

e. Refer to column 6, planning factors table, and determine the total number of fire units recommended for the 1,250-yard ring. Place these units around the vulnerable area, approximately 1,250 yards outward from the outer edge of the area and approximately equally spaced. Alternate the 40-mm and caliber .50 machine-gun fire units as far as practicable. Coordinate their locations with fire units already placed.

Note. Another equally effective method of placing fire units on the 1,250-yard ring is as follows:

Refer to column 6, planning factors table, and determine the number of 40-mm fire units recommended for the 1,250-yard ring. Place these units on the 1,250-yard ring approximately equally spaced. Refer again to column 6, planning factors table, and determine the number of caliber .50 machine-gun fire units recommended for the 1,250-yard ring. Place these units on the 1,250-yard ring approximately equally spaced, coordinating their locations with the 40-mm fire units already placed.

f. Coordinate the dead areas of fire units by considering existing masks and insuring that the dead area of one fire unit is covered by the fire of another fire unit.

g. Analyze the defense.

h. Shift fire units as necessary to correct weak spots.

i. Make a ground reconnaissance to select fire unit position areas as close as possible to those determined by the map reconnaissance.

j. Based on the actual position areas selected, reanalyze the defense. If this analysis indicates that the defense is not the type desired, successive relocations of fire unit position areas will be nec-

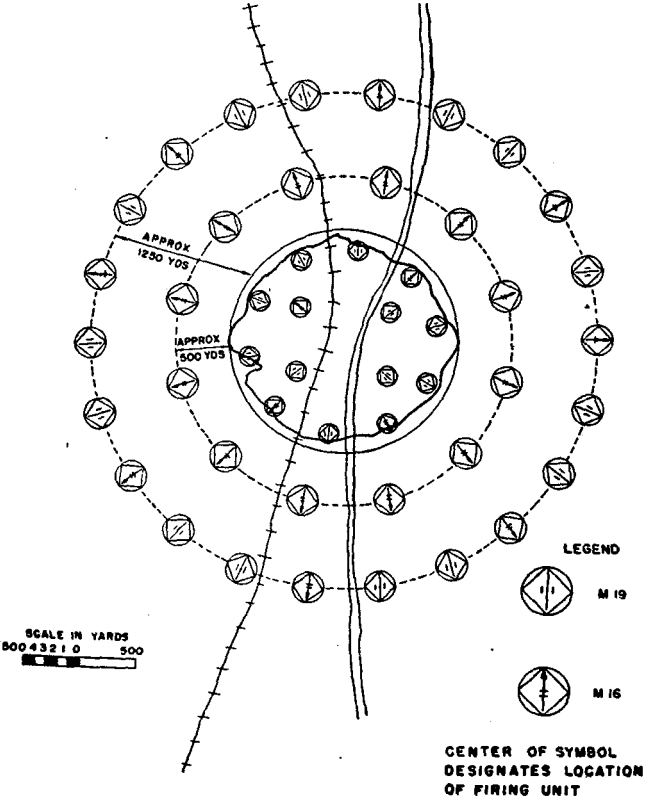


Figure 30. Completed defense for a vulnerable area.

essary until a satisfactory solution has been reached. Figure 30 is an example of a completed area defense.

Note. When more than the minimum number of fire units, as indicated in the planning factors table, are available, the defense is increased in density and/or extended in depth.

Section IV. ESTABLISHING A DEFENSE WITH MAJOR TERRAIN DIFFICULTIES

97. GENERAL

When major terrain difficulties are encountered, all fire units cannot be located where they would be the most effective, consequently the defense must be specially designed in order to obtain the best possible defense. Normally, a terrain difficulty will require greater density of fire units or larger caliber light AAA guns in the sector where the difficulty occurs.

98. PROCEDURES, MAJOR TERRAIN DIFFICULTIES

a. In establishing a defense with major terrain difficulties the same assumptions made in designing a defense of a vulnerable area (par. 95) hold true except that major terrain difficulties are encountered.

b. Should any of the other assumptions be materially changed, then it would be necessary to establish a special defense based upon the existing conditions.

c. The general procedures for the establishment

of a defense involving major terrain difficulties are as follows:

(1) Plot the vulnerable area on a suitable map or overlay and define it by drawing a solid line around the installation(s) to be defended.

(2) Refer to the planning factors table (table III) and determine the minimum number of batteries required to defend the area and the suggested disposition of fire units. If the matériel available does not meet the minimum requirements for the defense an adequate defense cannot be established.

(3) Place fire units within and around the vulnerable area in a checkerboard pattern. Space fire units 300–600 yards apart. For the number and types of fire units see column 4, planning factors table.

(4) Place caliber .50 machine-gun fire units around the vulnerable area approximately 500 yards from the outer edge of the area and approximately equally spaced. Coordinate their location with fire units already placed. Disregard the terrain difficulty. For the number and types of fire units see column 5, planning factors table.

(5) Refer to column 6, and determine the total number of fire units recommended for the 1,250-yard ring. Place these units

around the vulnerable area, approximately 1,250 yards outward from the edge of the area and approximately equally spaced. Whenever possible alternate the placing of 40-mm and machine-gun fire units. Disregard the terrain difficulty.

(6) Analyze the terrain difficulty to determine if the direction of attack or if the type of attack is limited because of the terrain difficulty. Based upon this analysis, determine what effect the terrain difficulty will have upon the defense design. The difficulty may cause the defense to be compressed in the sector of the difficulty or, conversely, expanded.

(7) Relocate those fire units that normally would have been placed in the sector of the terrain difficulty in accordance with the analysis made in the sixth procedure above.

(8) Coordinate the dead areas of fire units.

(9) Analyze the defense.

(10) Shift fire units as necessary to correct weak spots.

(11) Make a ground reconnaissance to select fire unit position areas as close as possible to those determined by the map reconnaissance.

(12) Based on the actual position areas selected, reanalyze the defense. If this analysis indicated that the defense is not the type desired, successive relocations

of fire unit position areas will be necessary until a satisfactory solution has been reached.

d. Figure 31 is an example of a completed light AAA defense in which the difficulty was a large body of water causing the defense to be compressed in the sector of the terrain difficulty.

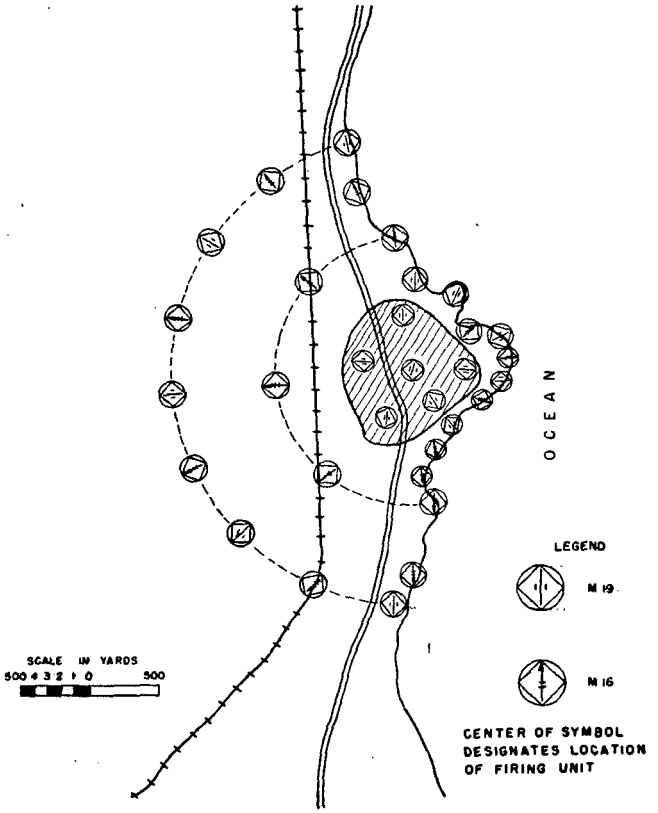


Figure 31. Completed defense with a major terrain difficulty.

Section V. SPECIAL CONSIDERATIONS

99. SPECIAL CONDITIONS OF ATTACK

In establishing light AAA defenses there may be special considerations which will cause the enemy to canalize the direction or type of attack. The three main considerations which will affect the enemy's attack are:

a. Probable routes of approach.

b. Forced routes of approach.

c. Nature of the installation or AAA defenses as they affect the type of attack.

100. PROBABLE ROUTES OF APPROACH

a. In general the enemy is capable of attacking from any direction. However, he will seek those routes which are most favorable to him. These probable routes of approach may be influenced by the following factors:

(1) Terrain (water, woods, mountains).
(2) Adjacent defended areas.
(3) Navigational aids such as roads, rivers, railroad tracks, and towns.
(4) Tactics, techniques, and capabilities of the enemy.
(5) Size, shape, and nature of the vulnerable area.
(6) AAA defenses of the vulnerable area.

b. When a probable route of approach is indicated because of one or more of the above factors, light AAA defense designs are affected as follows:

(1) For a defense where all of the available matériel is required to provide a balanced defense, with gun density at the minimum, no emphasis can be placed on the probable route(s) of approach. The integrity of a balanced defense is not weakened below the minimum at the expense of providing greater strength along the probable route(s) of approach. However, defense design may be improved and defensive strength may be increased along those routes of approach by a slight rotation of the outer ring.

(2) In those defenses where the gun density is not at the minimum, some fire units should be placed along the probable route(s) of approach. The criteria in this case are to first provide a balanced defense with the minimum gun density and then to place the remaining fire units along the probable route(s) of approach.

101. FORCED ROUTES OF APPROACH

a. Often, the enemy must confine his attack to a forced route of approach if he is to be effective. This route may be influenced by the following factors:

(1) Terrain.

(2) Nature of the vulnerable area.

b. When a forced route of approach is indicated, light AAA defenses are specifically designed to provide density and depth along this route. For

example, a fighter strip that is located between two parallel ridges which are relatively close together, could not be effectively attacked from the direction of the ridges. The enemy would be compelled to strike from a direction parallel to the ridges. In this case the light AAA defense would be designed primarily for the forced routes of approach.

102. NATURE OF THE INSTALLATION

The nature of the installation and/or AAA defenses of an area will sometimes dictate a specific type of attack or eliminate the possibility of one or more types of attack. For example, to effectively attack a submarine pen constructed with bombproof overhead covering, the type and direction of attack would be limited. In this case a bomb would have to be placed in the opening of the submarine pen, and the type of attack would be limited to a minimum altitude and from that direction in which the bomb could enter the submarine pen. The defense would be specially designed for a minimum altitude attack to cover the forced route of approach.

103. COMPOSITE DEFENSES

A composite defense is formed when light AAA fire units are employed with other types of AAA fire units. The design procedures for light AAA composite defenses are in general the same as those discussed in paragraphs 95 and 98. In a composite defense employing medium or heavy

AAA units with light AAA units, design procedures are affected as follows:

a. Medium or heavy defenses are established first, these to include the siting of organic security weapons (4 quadruple caliber .50 machine-gun mounts per medium or heavy fire unit).

b. The light AAA defense is then established considering the location of the organic security weapons of the medium or heavy AAA fire unit. If possible, these security weapons are integrated into the defense. In certain circumstances it may be desirable to employ these security weapons away from the medium or heavy unit and use them to either establish or supplement the light AAA defense. This decision will be made by the antiaircraft defense commander.

104. INTEGRATED AND COORDINATED DEFENSES

When more than one light AAA defense appears in the same area, every effort should be made to integrate or coordinate defenses. When the areas are close enough together, the defenses should be integrated. If the areas are too far apart for integration but some weapons on the outer rings of each defense are within supporting distance of each other, the defenses should be coordinated. If the distances between defenses are so great as to preclude integration or coordination, adjacent defenses still will be able to add depth to the defense against minimum altitude and low level attacks. This fact must be considered in balancing the defense.

105. DEFENSE EMPLOYING ORGANIC ANTIAIRCRAFT WEAPONS OF OTHER UNITS

a. Organic antiaircraft weapons of any unit located within the defended area of a light AAA defense should be integrated into that defense consistent with control measures established by higher commanders.

b. If possible these organic AAA weapons are tied into the local antiaircraft operations center. Communications will be provided and established by the local AAA unit.

Section VI. FIRE DIRECTION

106. SECTORS OF FIRE

As an aid to fire direction, surveillance, and selection of targets, the AA defense commander should establish sectors of fire. Each fire unit should be assigned a primary sector of fire and a contingent sector of fire. The primary sector of fire should be of such size that all fire units (of one type), at the same distance from the vulnerable area, will be responsible for approximately equal primary sectors. In all cases it is normal to overlap adjacent assigned sectors of the same weapons. Since the 40-mm guns and the caliber .50 machine-guns have different ranges, sectors of fire should be assigned for each type of weapon. For example, all 40-mm fire units on the outer ring in the defense of a vulnerable area should have approximately equal primary sectors with adjacent sectors overlapping. The AA defense

commander should establish rules for the selection of targets within the primary and contingent sectors of fire.

107. TARGETS

a. If only one target appears, it should be engaged as long as possible by all fire units that can effectively engage it.

b. If more than one target appears, two principles are involved:

(1) Engage as many targets as possible.

(2) Mass as much effective fire as possible on each target. Often these principles are in direct conflict, and the fire unit commander must decide which principle to employ in order to best accomplish his mission. Targets appearing in the primary sector of fire of a unit normally are engaged before those in a contingent sector. Normally, the leading target should be engaged by all the fire units that can bring effective fire upon it. Succeeding targets that are approaching the best field of fire should then be engaged.

(3) Other considerations being equal, priority of fire is given to that target or targets which present the greatest threat to the defended area.

108. RULES FOR SELECTION OF TARGETS

In order to engage the maximum number of targets more effectively, the following considerations

can be used as a guide to determine when to start and when to break off an engagement:

a. With respect to the fire unit, approaching targets are more profitable to engage than receding targets.

b. The best portion of an incoming course starts at maximum effective range and continues up to about midpoint.

c. Transfer time, plus time of flight to the new target, must be considered.

d. Every effort should be made to have each target engaged prior to its bomb release.

CHAPTER 10

ANTIAIRCRAFT OPERATIONS CENTER AND ANTIAIRCRAFT ARTILLERY INFORMATION SERVICE

Section I. INTRODUCTION

109. GENERAL

The principles of organization, operation, and functions of the antiaircraft operations center (AAOC) and the antiaircraft artillery information service (AAAIS) as set forth in this chapter are to be used as a guide for their establishment. Each antiaircraft defense will present a different problem which must be solved by the application of these principles, modifying them as necessary to arrive at a sound solution.

110. AAOC—AAAIS RELATIONSHIP

The AAOC and AAAIS will be discussed separately, but in practice each is closely related to and supplements the other. The relationship between these and other agencies is indicated in figure 32.

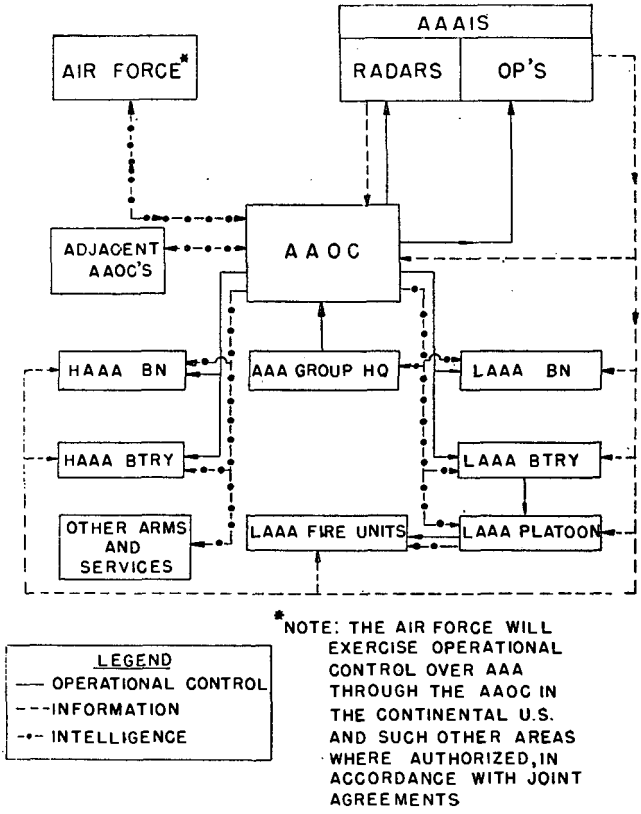


Figure 32. AAOC—AAAIS relationship (AAA group level).

Section II. ANTIAIRCRAFT OPERATIONS CENTER (AAOC)

111. GENERAL

a. The antiaircraft operations center is the tactical or battle headquarters of the antiaircraft de-

fense commander. It is in this center that all of the information available to the antiaircraft defense is collected, evaluated, and disseminated as intelligence. It is in this center and through this agency that the antiaircraft defense commander exercises operational control of all elements of the antiaircraft artillery defense.

b. An antiaircraft operations center is organized and operated in each area defended by antiaircraft artillery by the senior (or designated) antiaircraft artillery headquarters in the defense. When an AAA brigade or group headquarters is present, an antiaircraft artillery operations detachment (T/O&E 44–7) normally will be provided to operate the AAOC. When an antiaircraft artillery operations detachment is not provided, the principles and procedures are the same, but the equipment must be partially improvised and the operating personnel drawn from the units of the defense.

c. Centralized control for each AA defended area is obtained by establishing the AAOC at the highest AA echelon in the area. If communications facilities are inadequate due to the distance between units or the number of units within the defense, or for any other reason, operational control should be exercised through one or more subordinate AAOC's.

112. FUNCTIONS

a. The AAOC coordinates all of the available antiaircraft artillery so as to engage an enemy

with maximum effectiveness. To accomplish this, the AAOC has two primary functions:

(1) The collection, evaluation, and dissemination of information and intelligence.

(2) The exercise of operational control, including fire direction, when and as necessary.

b. The secondary functions of the AAOC are:

(1) To act as a center for liaison and coordination with other agencies.

(2) To provide higher, lower, and adjacent headquarters with pertinent information.

(3) To provide warning of the approach of hostile aircraft to other arms and services.

(4) To provide the AA defense commander with information on the effectiveness of the defense.

(5) To perform certain routine functions, such as the collection and dissemination of meteorological data, the preparation and maintenance of necessary statistics and records, and the submission of reports.

113. COMMAND

The AAOC is under the command of the AA defense commander. He is responsible for its organization and operation. He normally delegates the duty of organizing the AAOC and supervising its operation to his executive officer.

114. ALTERNATE AAOC's

The AA defense commander will designate one or more of the AAOC's of the defense as an alternate. Alternate AAOC's will be prepared to assume the functions of the senior AAOC in the event the senior AAOC goes out of action.

115. SUBORDINATE AAOC's

When the area of responsibility of the AA defense commander is such that the senior AAOC cannot directly control all of the elements of the defense, subordinate AAOC's will be established. Normally, such a situation will be dependent upon the capabilities of the communication facilities of the defense. These AAOC's will assume operational control of the designated fire units under the direction and supervision of the senior AAOC of the area.

116. INFORMATION AAOC's

In a defense composed of more than one battalion, each subordinate group or battalion may establish information AAOC's to keep the unit commanders and staffs informed of the situation. One or more of these information AAOC's may be designated as an alternate, but they have no operational control of their fire units as long as the senior or alternate AAOC's remain in operation.

117. LOCATION OF THE AAOC

a. The AAOC must be located where it can best exercise operational control over the fire units of the defense. However, it is also desirable to locate

the AAOC where coordination with Air Force control or intelligence agencies will be facilitated.

b. Unless adequate protection exists for the AAOC and communication facilities the AAOC normally should not be located within the vulnerable area.

118. THE ANTIAIRCRAFT ARTILLERY OPERATIONS DETACHMENT (AAAOD)

a. Mission. The AAAOD (T/O&E 44–7) is an AAA organization with the mission of providing the brigade or group to which attached with the equipment and personnel to operate an AAOC.

b. Attachment. The AAAOD is attached to a brigade, group or other units as required. Normally, these units are not attached to a battalion. The AAAOD is dependent upon the unit to which it is attached for messing.

c. Personnel and Equipment.

(1) *Personnel.* The AAAOD is composed of personnel whose duties include administration, communications, operations, and supervisory duties pertaining to the AAOC. The strength of the unit is based on normal operating requirements, and when the local situation is such that additional personnel are required they must be provided by the group or brigade to which attached.

(2) *Equipment.* The AAAOD is authorized one operations center AN/TTQ–2, and limited radio and wire communication equipment. To obtain the maximum op-

erating efficiency for the defense, the communication facilities of the AAAOD and the unit to which attached should be consolidated. In this manner, a more complete AAOC–AAAIS communication system can be installed with maximum economy of communications equipment.

119. AAOC EQUIPMENT AND PERSONNEL

For the operation of the AAOC, certain equipment is required to facilitate the collection, evaluation, and dissemination of intelligence. AAAOD's are authorized an operations center set, and AAA battalions are authorized plotting equipment. The plotting equipment, while not as elaborate as the operations center set, provides the necessary minimum equipment to operate a battalion AAOC. AAA groups and brigades, with no attached AAAOD, must improvise the necessary equipment. For detailed information on these sets see TM 11–448, TM 11–2581, and TM 11–2582.

120. AAOC OPERATION

For details of the operations of an AAOC, see FM 44–8.

Section III. ANTIAIRCRAFT ARTILLERY INFORMATION SERVICE (AAAIS)

121. GENERAL

a. The antiaircraft artillery information service is organized primarily to provide elements of

the antiaircraft defense with local warning of the approach of hostile aircraft. It is organized, equipped, and trained to obtain accurate information of aerial activity with which to warn the defense fire units of enemy attack or the approach of friendly aircraft. It also serves to warn the defenses of any other enemy activity in the area. It provides the defenses with timely information which will enable them to engage the enemy most effectively.

b. A well-established AAAIS provides for the contribution of information by all elements of the defense so that rapid distribution of pertinent intelligence to the units concerned may be made by the AAOC. The AAAIS supplements the long-range warning received from the Air Force.

c. A well-established AAAIS permits the most economical employment of personnel and equipment. This will not only result in a saving of matériel by the defense but will also permit the weapons of the defense to be maintained with the highest order of efficiency. In a defense reasonably assured of adequate warning, it will not be necessary to have complete manning personnel always at their equipment.

122. COMMAND

The antiaircraft defense commander is responsible for the establishment and operation of the antiaircraft artillery information service. He normally delegates the duty of coordinating the AAAIS facilities to his S2. The S2 in turn will

require the assistance of the communication officer and radar officer to do this.

123. CONTROL

All AAAIS facilities are coordinated and controlled by the AA defense commander.

124. AAAIS FACILITIES

The AAAIS embraces all available sources of information within the defense. There are two principal sources of information organic to the AAA. These are:

a. Radar. T/O&E's authorize radars to AAA units for surveillance purposes. When necessary, the surveillance radars may be supplemented by the use of gun-laying radars or target-acquisition radars. Such radars generally lack the range and pickup characteristics desirable for warning purposes; however, they are suitable for AAAIS to a limited degree. The SCR–584 gun-laying radars have a search range of 70,000 yards.

b. AAAIS OP's. Ground AAA observation posts are established for the primary purpose of giving flash warning of low-flying aircraft to the AA defense. The secondary purpose of these observation posts is to give warning of any hostile surface activity that might affect the defense. This permits the light AAA crews to locate and track the approaching target in sufficient time to open fire at effective ranges. Other units in the defense receive this warning primarily for local defense of their positions.

125. EMPLOYMENT OF AAAIS RADARS

a. General. To provide effective local warning for the AA defenses, AAAIS radars must be sited to obtain maximum operating efficiency. This requirement concerns the technical aspects of the individual radar sites and also the planning for the over-all coverage of the area. Radars must be able to locate minimum-altitude targets at satisfactory ranges from the defense, and sites should be selected to avoid blind spots in the over-all radar coverage.

b. Siting. The technical requirements for the individual radar sites are covered in appropriate technical and field manuals.

(1) The location of a general area within which a site will be selected for the surveillance radars is dependent on the following:

(*a*) Terrain features affecting radar employment and efficiency.

(*b*) Availability and effectiveness of other sources of early warning.

(*c*) Number of surveillance radars available for AAAIS in the defense.

(*d*) Communication facilities available.

(*e*) Accessibility of sites.

(*f*) Necessity for local security of the radar position.

(*g*) Administrative considerations. These will include supply, housing, maintenance of equipment, and control of the personnel concerned.

(2) Within the general area selected for a surveillance radar, the radar officer should be allowed the final selection of the exact radar location. In some instances it may be necessary to actually set up and operate the radar in each of several possible sites within the general area in order to select the site providing the best performance.

c. Coordination. AAAIS radars must be coordinated so far as coverage is concerned. They must also be properly scheduled for operation. A radar cannot operate without relief for maintenance and repairs, nor can the radar crew operate for extended periods of time without rest. A schedule must be established so that only a part of the total AAAIS radars are on duty at one time to obtain the desired coverage. Other radars must be kept on a stand by status, meaning that they are available for duty immediately on order. Some radars must be released from time to time to allow for repairs and proper maintenance.

126. EMPLOYMENT OF OBSERVATION POSTS (OP's)

a. Purpose. AAAIS observation posts are established to warn of the approach of low-flying aircraft which may avoid detection by the radars. Information concerning the direction of approach, altitude, number of aircraft, and the observer's recognition is sent to the fire units of the defense. This assists them in engaging hostile aircraft with maximum efficiency at the maximum range of the weapons. The observation posts will also

provide information of other enemy activity to the elements of the defense.

b. Control and Coordination.

(1) In a coordinated defense consisting of several light AAA battalions, the S2 of the AA defense commander coordinates the location of the AAAIS OP's. Consideration must be given to covering any blind spots in the radar net.

(2) When vulnerable areas are in the same general area, but not a part of either integrated or coordinated defenses, the number of OP's required may be reduced by coordinating the OP coverage of two areas. The determining factors will be the terrain, distance between vulnerable areas, distance the OP's can be located from the vulnerable areas, number of OP's available, and the capabilities of the communication systems established. When such coordination is desirable, it will be accomplished by mutual agreement between the commanders concerned.

c. Siting. AAAIS OP's should be located the maximum distance from the vulnerable area at which a complete coverage of all necessary approaches can be obtained. The maximum distance that OP's may be located from the defense is limited by communication facilities. When a continuous ring of OP's is required, the distance between adjacent OP's is limited by the distance an

observer can detect the presence of an aircraft. To prevent an aircraft from passing undetected midway between two adjacent OP's, a safe overlap must be provided. The maximum distance between adjacent OP's under normal conditions is approximately 10 miles. Where terrain or visibility conditions limit observation, the distance between adjacent OP's must be reduced. Advantage should always be taken of any high points such as hills, mountains, towers, or trees. Within the general area selected for the OP, the actual site should provide the following characteristics:

(1) Field of view and absence of masks.
(2) Access routes.
(3) Concealment.
(4) Ease of installation.
(5) Ease of establishment and maintenance of communication.
(6) Ease of administration.
(7) Security of OP.

d. Functions of the OP Observers. Observers manning OP's are to:

(1) Maintain continuous visual surveillance over the assigned sector.
(2) Detect by visual observation the presence of aircraft.
(3) Recognize, if possible, the aircraft as friend or foe.
(4) Report over the OP net any aircraft observed.
(5) Observe and report any enemy activity.

e. Air Guards. In addition to the OP's, air guards are needed at the AAA fire units to supplement the AAAIS for very close-in warning. They are employed to discover and report the approach of low-flying aircraft. It may be necessary to have an air guard just over a nearby hill or beyond a clump of trees or other mask to furnish warning and direction for the initial pointing of the weapons.

CHAPTER 11

SURFACE MISSION

127. GENERAL

In a surface mission antiaircraft artillery may be employed as follows:

a. To engage surface targets (ground and waterborne).

b. To provide fire support to other combat units by:

(1) Reinforcing field artillery fires.
(2) Acting in lieu of field artillery.
(3) Augmenting the fire of a supported unit's weapons.
(4) Acting as the supported units fire support weapons.

c. When AAA units are assigned a surface mission they should monitor the operational control and intelligence nets of the nearest AAOC so that those units with available AAA fire control equipment can effectively engage hostile aerial targets when such action will not interfere with the assigned mission.

128. CAPABILITIES AND LIMITATIONS OF AAA WEAPONS

a. General. To properly employ AAA in a surface mission, a thorough understanding of the

capabilities and limitations of AAA weapons is necessary. It must be borne in mind that these weapons are primarily designed to engage aircraft in an air defense mission and not ground targets in a surface mission.

b. Medium and Heavy AAA.

(1) Antiaircraft artillery guns are characterized by their high rate of fire; unlimited traverse (the ability to traverse 360°, which makes them an excellent weapon to protect flanks of a sector); their relatively long range, comparable to medium field artillery; and their high muzzle velocity and penetrating ability which is effective against fortifications and armored vehicles.

(2) Some of the important limitations are: The limited flexibility of ammunition, mainly the lack of multicharge characteristics such as that of field artillery; lack of tactical mobility; lack of destructive power against area targets; flat trajectory, which is desirable for direct firing but a disadvantage for indirect fire; and high silhouette which make the guns difficult to revet and camouflage.

c. Light AAA.

(1) Some of the desirable characteristics of light AAA are: Their high cyclic rate of fire; high muzzle velocity which enables them to fire on light emplacements with considerable penetrating power; ac-

curacy which makes them valuable for firing at pinpoint targets; and their mobility, particularly in self-propelled units.

(2) Some of the important limitations of light AAA are: Flat trajectory fire which make hull defilade difficult; high silhouette making camouflage and revetment difficult; lack of protective armor; dead space over cab; noise, particularly in self-propelled weapons when moving into position; and ammunition characteristics.

129. FIELD ARTILLERY MISSION

a. When acting as field artillery, medium and heavy AAA will assume the same status as the field artillery, that is, to support combat units on the field of battle. It does this by neutralizing or destroying those targets which are most dangerous to the supported arm and by giving depth to combat by counterbattery fire, fire on hostile reserves, by restricting movements in rear areas, and by disrupting hostile command agencies. Antiaircraft artillery units in a field artillery mission will apply, as far as practicable and applicable, the principles, techniques, and tactics of the field artillery. A fire direction center will be established comparable to that of the field artillery. For field artillery references see FM's 6–20, 6–40, and 6–101.

b. In support of combat units, AAA will normally reinforce field artillery units. However,

they may be assigned any one of the following field artillery tactical missions:

(1) Direct support.
(2) General support.
(3) Reinforcing.
(4) General support, reinforcing.

c. For the implications included in the assignment of one of these tactical missions, see table IV.

d. In addition to the above field artillery tactical missions, AAA units may be assigned an alternate reinforcing mission. This is a surface firing mission which may be assigned to AA units sited for *air defense* but within range of enemy surface targets. The fires of a nearby field artillery battalion may be reinforced by a medium or heavy AAA unit while the AAA unit is not engaged in air defense fires. The reinforced field artillery battalion will not control the AAA battery (battalion) in any way and may only *request* surface fires. If the accomplishment of the air defense mission is jeopardized by granting such requests for fire, these requests must be refused or postponed until such time as the surface fires can be delivered without impairing air defense effectiveness.

130. AUGMENTING THE FIRE OF A SUPPORTED UNIT

a. When AAA is used to augment the fire of a supported unit's weapons or to act as the supported unit's weapons, it will normally be attached to the supported unit. For details of employment see FM 44–2 and FM 44–4.

b. When light AAA is assigned a mission of close support of infantry or armor, part of the weapons are given such missions as interdiction, harassing, and neutralization types of fire. The remainder of the weapons augment the infantry or armor heavy weapons in furnishing close support by overhead fire and fire through gaps in the friendly lines. These close support weapons aid in limiting enemy penetration, fire within portions of the defended area that have been penetrated by the enemy, and support friendly counterattacks.

c. For details of employment, see FM's 44–2, and 44–4.

131. ANTIMECHANIZED DEFENSE

AAA may be used in an antimechanized defense. When so used, the fire unit is normally the individual gun. The armor-piercing ability and high rate of fire of medium and heavy AAA when using an armor piercing shell make them particularly effective against tanks and armored vehicles. Light AAA can effectively engage lightly armored vehicles. AAA weapons can be used effectively in controlling avenues of approach into which enemy vehicles may be canalized by other weapons of the defense or terrain.

132. WATERBORNE TARGETS

AAA may be employed against waterborne targets such as motor torpedo boats, landing craft, destroyers, transports, submarines and other types

of naval craft. Heavy and medium AAA can be employed against noncapital vessels while light AAA is effective against motor torpedo boats and light landing craft within 1,000 yards range. When AAA is employed in a surface mission against naval craft and located in or near a harbor defense, its employment should be coordinated by the harbor entrance control post.

133. RADAR

a. General. When not required in the air defense mission, AAA radars may be employed for the location of surface targets. The use of the radar in this capacity normally requires that it be sited at a distance from the AAA unit to which assigned. Therefore, the employment of AAA radars in the surface mission is a command decision. When employed in conjunction with another service, close coordination, liaison, and communication with the supported unit must be maintained.

b. Employment. Radars are employed to perform the following surface tasks:

(1) Location of hostile mortars and artillery.
(2) Adjustment of artillery and mortar fire on enemy targets.
(3) Location and surveillance of friendly and hostile troop and vehicle movement, including bridge and road watching.
(4) Surveillance of water approach area.
(5) Assist in the registration of friendly artillery during periods of darkness or poor visibility.

CHAPTER 12

SPECIAL CONDITIONS OF EMPLOYMENT

134. GENERAL

When antiaircraft artillery is employed under conditions which may impose special problems caused by climate, terrain, nature of the operation, or a combination thereof, some adjustments in plans, training, and techniques may be necessary to cope with these situations.

135. TACTICS

The tactical principles for the employment of antiaircraft artillery involved in these special operations are, in general, the same as for any normal type of operation. The problems and differences which arise from these special operations are mainly in training, movement, and logistics.

136. SPECIAL OPERATIONS

a. Amphibious Operations. For details on amphibious operations see FM's 100–5 and 31–5.

b. Desert Operations. For details on desert operations see FM's 100–5 and 31–25.

c. Mountain Operations. For details on mountain operations see FM's 100–5 and 70–10.

d. Jungle Operations. For details on jungle operations, see FM's 100–5 and 72–20.

e. Airborne Operations. For details on airborne operations see FM's 100–5 and 71–30.

f. Winter and Arctic Operations. For details on winter operations see FM 70–15.

CHAPTER 13

COMMUNICATIONS

Section I. INTRODUCTION

137. GENERAL

a. AAA communications include all the available means employed to transmit orders, intelligence, and commands between AAA units and to establish liaison with supported and adjacent units. Communications between the various command posts, and with service elements, are required for normal command and administration within the AAA units. An intelligence net is also required to transmit timely warning of the approach of hostile aircraft. In lower echelons, communications must be established for fire direction and for use by air guards. Internal communications for AAA units normally will be provided by communications personnel of the unit.

b. Long-lines communications normally will be provided by signal corps agencies, and commercial facilities are utilized whenever possible. Existing facilities should be exploited to the fullest extent.

c. For details on AA communications see FM's 24–5, 44–8, and 100–11.

138. RESPONSIBILITY FOR COMMUNICATIONS

a. The commander of the tactical unit is responsible for communications within his unit. The Communication Officer of each unit, down to and including battalion, exercises immediate supervision over the installation, operation, and maintenance of the unit's communications agencies. He is also responsible for advising the commander on the employment of all communication facilities available to the unit.

b. To insure coordination, the commander of each tactical unit exercises both tactical and technical control over communication agencies of subordinate units. Tactical control insures the establishment of necessary communications between units in accordance with the tactical plan. Technical control standardizes the installation, operation, and maintenance of the various means of communication. To expedite technical control, the communication officer deals directly with the communications officers of subordinate units.

c. When an AAA unit is protecting a unit or installation, it establishes liaison with the unit it is supporting. The supporting unit is responsible for establishing the required communications.

139. COMMUNICATION REQUIREMENTS

In order to meet communication requirements and standardize the procedure in the establishment of necessary communication nets, the following nets and procedures should be used:

a. Command Net. A radio, wire, or combined

radio and wire system of communication, over which commands are sent to various headquarters and units. In AAA units administrative matters will also be sent over this net. This is a two-way net and extends down to the AAA batteries.

b. Intelligence Net. That net or nets over which the AAOC disseminates intelligence. It may be either a radio net, a wire net, or both. This is a one-way net and extends from the AAOC down to the batteries of the defense. Intelligence broadcasts over this net are available to other arms and services. These units are provided radio receivers by T/O&E for this purpose. To use this intelligence, such units will require a simple plotting board gridded with the grid system used by the AA defenses.

c. Operational Control Net. That net or nets over which the commander controls operations of all units in an antiaircraft defense from the AAOC. This may be either a radio net, a wire net, or both. This is a two-way net and extends from the AAOC down to the batteries of the defense.

d. Radar Reporting Net. That net or nets over which radars, in a surveillance role within the antiaircraft defense, transmit data to the AAOC. This net may be either a radio net, a wire net, or both, and is a one-way net. Assignment of targets to be reported on by surveillance radars will be accomplished over the operational control net.

e. OP Net. That net or nets established for the transmission of the information obtained by the AAAIS observation posts. It is a one-way net from the AAAIS OP's to the light AAA fire units

and other elements as necessary. This is a two-way net between the AAOC and the OP's. The AAOC will supervise and monitor this net.

f. AAA Liaison Net. That net or nets established by an AAOC, as dictated by the situation, in order to obtain coordination and liaison with the Air Force, adjacent AAOC's, and/or other agencies. It may be a radio net, a wire net, or both. It is a two-way net.

140. MEANS AND EXTENT OF COMMUNICATION

The primary agencies for AAA communication are wire or radio, or a combination of the two, using remote control and radio-link carrier. The selection of the equipment and the extent of its use in the communication system depend on the following factors:

a. Facilities Available. Present tables of equipment provide for the issue of radios down to and including the fire unit. In the early stages of an operation or in a rapidly moving situation, radio forms the framework of the communication system. A complete wire system is installed when time permits. Wire carried by the unit may be supplemented by additional amounts drawn from signal corps. The availability of signal corps installations and commercial facilities influences the amount of wire to be laid; maximum use is made of existing lines.

b. Frequency of Movement. The frequency of movement determines the extent of wire communication that can be installed; in situations where

AAA units change positions often, little or no wire is laid. When an operation becomes stabilized and the AAA moves infrequently, an elaborate wire system may be established.

c. Terrain and Atmospheric Conditions. Atmospheric conditions and terrain affect the range of radio communication to such an extent that these conditions must be given great consideration in the selection of communication agencies to be employed.

d. Communication Discipline. To facilitate handling large volumes of communication traffic, orderly and systematic methods must be used. Brevity and correct procedure are necessary in both wire and radio communication. To obtain the maximum effectiveness of the communication system, it is essential for all personnel to be trained in communication discipline.

Section II. WIRE AND RADIO COMMUNICATIONS

141. WIRE COMMUNICATIONS

a. The amount of wire communication equipment authorized AAA units is limited. This amount is sufficient only for lines between essential command posts and for fire control within the unit.

b. Higher echelons are responsible for laying wire lines to their subordinate echelons.

c. Supporting units are responsible for laying wire lines to supported units.

d. When an AAA unit is employed in a surface mission as field artillery, the unit is normally connected to the appropriate field artillery fire direction center (FDC) by wire. When the AAA gun unit has the mission of reinforcing the fires of a field artillery unit, the laying of wire lines between the two units is a responsibility of the AAA unit.

e. When an AAA unit is employed in the surface mission in close support of an infantry unit, the AAA unit is responsible for establishing communication with the supported unit.

f. As soon as possible, and if equipment permits, alternate wire lines should be established in order to ensure continuity of communication.

142. RADIO COMMUNICATIONS

There are two general types of radio sets authorized AAA units.

a. Frequency Modulated (FM) Set. The frequency modulated set is a line of sight, static-free radio, usually used in nets which require only a short-range radio.

b. Amplitude Modulated (AM) Set. The amplitude modulated set is a long-range radio which is subject to static interference and jamming. It is normally used in nets which require longer operating distances.

CHAPTER 14

SUPPLY AND EVACUATION

143. GENERAL

It is the responsibility of each echelon in the supply chain to push supplies forward within reach of the elements and units which will utilize them. However, each commander is responsible for making his requirements known to higher authority and for making the necessary arrangements for drawing and distributing supplies allocated to his unit. Antiaircraft artillery brigades and groups are responsible for the supervision of supply and administration of their subordinate units. This includes the determination that subordinate units have adequate supply and administration and, in the event critical items are in short supply, that they are properly distributed. When necessary, brigade and group commanders will issue instructions as to the allocation of ammunition.

144. SUPPLY AND EVACUATION PROCEDURES

a. Procedures and planning factors for supply and evacuation are set forth in appropriate field and technical manuals, including FM's 100–10

and 101–10. Supply and evacuation procedures for antiaircraft artillery will be dependent upon the location of the unit. There are four general locations which will influence supply and evacuation procedures:

(1) In the continental United States.

(2) In the communications zone.

(3) In the combat zone.

(4) In a theater or area where they are wholly dependent upon the Navy or Air Force for supply and evacuation.

b. Units located in the continental United States will receive logistical support from the continental armies and will follow the procedures set forth by the army commanders to secure the necessary supplies and take care of their evacuation.

c. Units located in communications zones will follow the procedures laid down by the zone commanders for supply and evacuation. These in general will follow those set forth in FM 100–10.

d. Units located in the combat zone will follow the supply and evacuation procedures prescribed by the army commanders. These in general will follow those set forth in FM 101–10.

e. Units located in a theater or area wholly supplied by Navy or Air Force will follow the regulations and procedures, prescribed by the senior naval or air force commander present. Units lo-

cated in these areas should immediately apprise the supply agencies of the Navy or Air Force of their specialized requirements in order that those agencies may take the necessary action to secure specialized supplies from army sources.

145. SUPPLY ECONOMY

AA units will exercise supply economy as set forth in FM 100–10.

CHAPTER 15

RECONNAISSANCE, SELECTION, AND OCCUPATION OF POSITION BY HIGHER AA ECHELONS

Section I. INTRODUCTION

146. GENERAL

This chapter deals primarily with the reconnaissance and selection of positions by AAA brigades and groups. Reconnaissance, selection, and occupation of position by battalion and subordinate units is discussed in detail in FM 44–2 and FM 44–4.

147. NATURE OF RECONNAISSANCE

The nature of reconnaissance will be dependent upon the mission assigned to the antiaircraft commander. If a surface mission is assigned, the commander will follow the principles for reconnaissance, occupation, and organization of positions as set forth in FM 6–20. If an air defense mission is assigned, the commander will design the defenses in accordance with the principles set forth in chapters 8 and 9 which include provisions for both map and ground reconnaissance.

148. DUTIES OF COMMANDERS

AAA commanders, whenever possible, precede their commands to the position to be occupied. The AAA commander should be in close touch with the force commander and his staff and must keep abreast with the situation and scheme of maneuver. He will make whatever reconnaissance is necessary to enable him to carry out his mission. Continuous reconnaissance before, during, and after selection and occupation of position is a primary requisite for all echelons of command.

149. TIME AVAILABLE FOR RECONNAISSANCE

Although the time available for reconnaissance varies with different situations, antiaircraft units must be able to go into position promptly and their employment must not be delayed by extensive reconnaissance. On the other hand, reconnaissance must be as thorough as time permits. Commanders should, if possible, allow sufficient time to subordinate units so that their reconnaissance can be completed during daylight hours. Due to various reasons, it may be necessary to rearrange the fire units after initial occupation of position.

Section II. RECONNAISSANCE BY HIGHER ECHELON FOR AIR DEFENSE MISSION

150. BRIGADE

Reconnaissance made by an antiaircraft brigade commander is chiefly a map reconnaissance

based upon the design of the defense as set forth in chapters 8 and 9. Information of the terrain is obtained from maps, aerial photographs, and reports. This study can be advantageously amplified by visual aerial reconnaissance. The selection of the command post area of the antiaircraft brigade is initially done by map reconnaissance and is usually verified by ground reconnaissance. Where necessary either to integrate or coordinate fire units of different organizations, it may be necessary for the brigade commander or his staff to make a ground reconnaissance of these positions.

151. GROUP

Reconnaissance made by the antiaircraft group commander is similar to that made by the brigade commander.

152. STATIC SITUATIONS

In the continental United States and possibly in the communications zone, an extremely detailed reconnaissance may be made by reconnaissance parties specially designated to determine the exact nature of the terrain, the ownership of land, and other items necessary to insure that the best practical defense is designed for a particular vulnerable area.

APPENDIX I

REFERENCES

FM 6–20	Field Artillery Tactics and Techniques.
FM 6–40	Field Artillery Gunnery.
FM 6–101	The Field Artillery Battalion.
FM 21–8	Military Training Aids.
FM 24–5	Signal Communications.
FM 31–5	Landing Operations on Hostile Shores.
FM 31–25	Desert Operations.
FM 44–2	Antiaircraft Artillery Automatic Weapons.
FM 44–4	Antiaircraft Artillery Guns.
FM 44–8	Antiaircraft Operations Room and Antiaircraft Artillery Intelligence Service.
FM 57–30	Airborne Operations
FM 70–10	Mountain Operations.
FM 70–15	Operations in Snow and Extreme Cold.
FM 72–20	Jungle Warfare.
FM 100–5	Field Service Regulations—Operations.
FM 100–10	Field Service Regulations—Administration.
FM 100–11	Field Service Regulations—Signal Communications Doctrine.
FM 101–5	Staff Organization and Procedure.
FM 101–10	Organization Technical and Logistical Data.
FM 110–5	Joint Action Armed Forces.
TM 11–448	Operations Center AN/TTQ–2.
TM 11–2581	Plotting Equipment AN/TSA–1.
TM 11–2582	Plotting Equipment AN/TSA–2.
DA Training Circular 23, 1951	Coordination of Fire Support.

DA Training Circular 18, 1950	Basic Tactical Principles for the Employment of Medium and Heavy AAA Guns in Air Defense.
DA Training Circular 6, 1952	Basic Tactical Principles for the Employment of Light AAA Guns in Air Defense.
DA Training Circular 28, 1951	The Antiaircraft Operations Center and Antiaircraft Artillery Information Service.
SR 110–1–1	Index of Army Motion Pictures and Film Strips and Kinescope Recordings.
SR 310–20 series	List of Training Publications.
SR 320–5–1	Dictionary of United States Army Terms.
SR 320–50–1	Authorized Abbreviations.
AR 220–50	Regiments—General Provisions.
AR 220–60	Battalions—General Provisions.

APPENDIX II

GLOSSARY

Alternate reinforcing mission—A surface firing mission which may be assigned to AAA units sited for air defense but within range of enemy surface targets. The reinforced unit may request fires from the AAA unit. If the execution of the fires requested does not interfere with or impair air defense effectiveness, it will be executed.

Antiaircraft artillery information service (AAA-IS)—A service organized, equipped, and trained to obtain accurate information of aerial activity with which to warn defense fire units of enemy attack or the approach of friendly aircraft.

Antiaircraft operations center (AAOC)—The tactical headquarters of an antiaircraft defense commander. It is the agency provided to collect, evaluate, and disseminate intelligence for the antiaircraft (AA) defense, and through which operational control over subordinate units is exercised by the AADC.

Air Defense—Air defense, as defined by the Joint Chiefs of Staff, includes all measures designed to nullify or reduce the effectiveness of the attack of hostile aircraft or guided missiles after they are airborne.

Assailability—The enemy's ability to hit a particular installation which is desired to be kept in operation.

Attrition rate—The rate of wearing down the enemy air force.

Bomb release line—An imaginary line around a defended area or objective over which a bomber should release its first bomb in order to obtain a hit on the near edge of the area or objective.

Composite defense—An antiaircraft artillery defense that employs two or more types of fire units which are integrated into a single defense.

Coordinated defense—AA defenses of two or more vulnerable areas, which are too far apart to form an integrated defense, but are so designed as to provide economy of matériel, greater effectiveness, and mutual support.

Criticality—A measure of the importance of an installation in relation to alternate means which will provide the same contribution to the military potential.

Fire unit analyzer—An instrument for analyzing the effectiveness of an antiaircraft fire unit against hostile aircraft or missiles under the conditions stated on the face of the analyzer.

Effectiveness clock—A form used in presenting the results of analysis of an AAA defense.

Gun-defended area—An air defense restricted area defined as the zone, and the air space above it, which is denied to friendly aircraft except under certain specified conditions.

Inner artillery zone—An air defense restricted area applied to specified air spaces within gun-defended areas which are denied to friendly aircraft under all conditions.

Integrated defense—An AA defense in which two or more vulnerable areas are defended with a single over-all defense.

Light AAA defense analyzer—A graphical overlay printed on a transparent material that enables the user to design and analyze a light AAA defense. There are two categories of light AAA defense analyzers; light AAA defense analyzer M1, 40-mm, light AAA defense analyzer M1, caliber .50 machine-gun (quad mount).

Optimum gun ring—An imaginary line around a vulnerable area or point which delineates the best distance outward from the center of the objective to emplace an antiaircraft fire unit in order to attain the best defense under the conditions stated.

Planning factors table—A table used as a guide in planning AAA defenses.

Recording form—A form used to tabulate index contributions of fire units in an AAA defense.

Restricted area—An area or air space in which there are special restrictive measures employed to prevent or minimize interference between friendly forces.

Recuperability—The ease and speed with which an installation can be rehabilitated in case it is damaged or destroyed by enemy attack.

Vital area—Any installation, air, ground, or port, whose destruction or damage by enemy action would have an adverse effect on military operations.

Vulnerability—The degree of susceptibility of a particular installation to damage from a given type and/or weight of attack by the enemy.

Vulnerable area—A vital area which requires air defenses. It is susceptible to less accurate forms of attack than a vulnerable point (defined below).

Vulnerable point—An important point which requires air defenses; normally of such a size as to necessitate precision attack.

APPENDIX III

Table I. AAA Planning Factors Table (90-mm)

Date: 11 Aug 1950

(Each AAA defense must be hand-tailored. These factors are for planning purposes only)

Size of Vulnerable Area Radius in Yards	4 Batteries		6 Batteries		8 Batteries		12 Batteries		16 Batteries	
	OGR Yards	Av Index	OGR Yards	Av Index	OGR Yards	Av Index	OGR Yards	Av Index	OGR Yards	Av Index
0	3000	25	3000	37	3000	50	3000	74		
1000	5000	20	5000	31	5000	40	5000	60	7000	84
2000			8000	27	10,000	39	10,000	59	10,000	78
3000			8000	23	10,000	34	12,000	48	12,000	73
4000					10,000	30	8 @ 12,000	43	8 @ 12,000	62
5000	Less than minimum effectiveness for morale purposes only.						4 @ 10,000		8 @ 11,000	
					10,000	25	6 @ 13,000	38	8 @ 15,000	54
							6 @ 10,000		8 @ 10,000	

NOTES

1. This table to be used for varying conditions of attack: Altitude—15,000 ft to 30,000 ft, Speed—200 mph to 400 mhp; Bomb run—at least 90 sec; Fuze—VT.

2. Each 90-mm fire unit must be located within 7500 yd of at least one other 90-mm fire unit.

3. This table for use with basic fire unit analyzer M1 dated 11 August 1950.

4. Gun rings listed above are the optimum for the size of the vulnerable area and the number of fire units indicated. These gun rings provide for continuous fire up to the BRL. They also provide minimum coverage over the vulnerable area. When minor terrain difficulties exist, fire units should be moved not more than + or —1000 yards radially. If the majority of attacks are expected at 25,000 ft or less and/or speeds up to 300 mph, a displacement toward the center of the vulnerable area is recommended. For higher altitudes and/or speeds, a radial displacement away from the vulnerable area is recommended.

5. The index numbers listed above represent an average for the 12 directions of attack. The average index number may not be obtained on each direction of attack.

6. For composite defenses, index numbers for 90-mm and 120-mm fire units can be added.

7. The effectiveness of a defense is not directly proportional to either an increase or decrease of index numbers or matériel. Twelve fire units in a defense do not give twice the effectiveness of six fire units.

8. In situations where the size of the vulnerable area is different from the sizes shown on the above table, the OGR values and average index numbers can be obtained with sufficient accuracy by straight line interpolation within the limits of the table. Extrapolation of this Table is not valid.

Table II. AAA Planning Factors Table (120-mm)

Date: 11 Aug 1950

(Each AAA defense must be hand-tailored. These factors are for planning purposes only)

Size of Vulnerable Area Radius in Yards	4 Batteries		6 Batteries		8 Batteries		12 Batteries		16 Batteries	
	OGR Yards	Av Index	OGR Yards	Av Index	OGR Yards	Av Index	OGR Yards	Av Index	OGR Yards	Av Index
0	3000	28	3000	41	8000	55	3000	82	----	--
1000	4000	22	4000	32	4000	44	4000	65	4000	88
2000			5000	27	5000	35	5000	54	5000	73
3000			8000	24	8000	32	8000	47	8000	64
4000			11,000	21	11,000	30	11,000	42	11,000	59
5000	Less than minimum effectiveness for morale purposes only.				13,000	28	13,000	42	13,000	59

NOTES

1. This table to be used for varying conditions of attack: Altitude—15,000 ft to 30,000 ft; Speed—200 mph—400 mph; Bomb run—at least 90 sec; Fuze—VT.

2. Each 120-mm fire unit must be located within 11,000 yd of at least one other 120-mm fire unit.

3. This table for use with basic fire unit analyzer M1, dated 11 Aug 1950.

4. Gun rings listed above are the optimum for the size of the vulnerable area and the number of fire units indicated. These gun rings provide for continuous fire up to the BRL. They also provide minimum coverage over the vulnerable area. When minor terrain difficulties exist, fire units should be moved not more than + or —1000 yards radially. If the majority of attacks are expected at 25,000 ft or less and/or speeds up to 300 mph, a displacement toward the center of the vulnerable area is recommended. For higher altitudes and/or speeds, a radial displacement away from the vulnerable area is recommended.

5. The index numbers listed above represent an average for the 12 directions of attack. The average index number may not be obtained on each direction of attack.

6. For composite defenses, index numbers for 90-mm and 120-mm fire units can be added.

7. The effectiveness of a defense is not directly proportional to either an increase or decrease of index numbers or matériel. Twelve fire units in a defense do not give twice the effectiveness of six fire units.

8. In situations where the size of the vulnerable area is different from the sizes shown on the above table, the OGR values and average index numbers can be obtained with sufficient accuracy by straight line interpolation within the limits of this table.

Table III. Planning Factors Table for Light AAA Date: 1 March 1951

Circular vulnerable areas; no terrain difficulties; no special considerations; all portions of vulnerable area of equal importance. (These figures are for planning purposes only; each defense must be hand-tailored.)

Maximum Diameter of vulnerable area (Yards)	Minimum No. of Batteries	Caliber of Fire Unit	No. of Fire Units in and Around Vulnerable Area	No. of Fire Units on 500-yd Ring	No. of Fire Units on 1250-yd Ring
500	1	40-mm	4		4
		.50-Cal		4	4
1000	2	40-mm	6		10
		.50-Cal		8	8
2000	3	40-mm	10		14
		.50-Cal	4	12	8
3000	4	40-mm	16		16
		.50-Cal	8	16	8
4000	5	40-mm	24		16
		.50-Cal	10	20	10
5000	7	40-mm	38	24	18
		.50-Cal	18	24	14
6000	9	40-mm	50		22
		.50-Cal	28	28	16

Note. Do not interpolate or extrapolate between figures in this table.

Table IV. Field Artillery Tactical Missions

A Field Artillery Battalion with a Mission of:	Answers Calls for Fire From:	Establishes Liaison with:	Establishes Communications with:	Has the Following Zone of Fire:	Must Furnish Forward Observers:	Displaces on Order of:
DIRECT SUPPORT	Sptd units. Own observers. Next higher Hq.	Sptd unit down to Bn level.	Sptd unit.	Z/A sptd unit. Additional zone as directed.	For Z/A of ea rifle or armd Co of sptd unit.	Bn comd.* Next higher Hq.
GENERAL SUPPORT	Next higher Hq. Own observers.	As directed by next higher Hq.	As directed by next higher Hq.	Z/A sptd unit, or as directed.	As directed by next higher Hq.	Next higher Hq.
REINFORCING	Reinforced unit. Own observers. Next higher Hq.	Reinforced unit.	Reinforced unit.	Z/F reinforced unit.	As requested by reinforced unit.	Reinforced unit.* Next higher Hq.
GENERAL SUPPORT REINFORCING	Next higher Hq. Reinforced unit. Own observers.	Comd Bn w/reinforced unit. As directed by next higher Hq.	Reinforced unit.	Z/A sptd unit, or as directed. Must include Z/F of reinf unit.	As directed by next higher Hq.	Next higher Hq.

* Notifies next higher Hq as to time and area.

INDEX

	Paragraphs	Page
Airborne AAA	App. II, 8*c*	152, 4
Airborne division	47	33
Airborne operations	136*e*	137
Aircraft control and warning group	42*a*	24
Air defense:		
Active		
Air force. (*See* Air force.)		
Combat zone (*see also* combat zone).	38, 46	22, 32
Committee	37	22
Communications zone	39, 45, 144*c*	23, 32, 145
Continental United States	36, 43*a*	21, 27
Definition	App. II, 28	152, 17
Joint training	43*f*	31
Limited means of	31	18
Mission. (*See* mission.)		
Objective of plan	40	24
Organization:		
Air force, continental:		
United States	40, 42*a*	24
Army AAA	42*b*	25
Command, control, general	43	27
Theater of operations:		
Communications zone	45	32
Combat zone	46	32
Division, AAA in	47	33
General	44	31
Passive	30*a*(2)	18
Priorities for. (*See* priority for air defense.)		
Purpose of	22	12

	Paragraphs	Page
Air defense—Continued		
Resources allocated for	28, 29	17
Tactical air. (*See* Tactical air.)		
Theater of operations	37, 44–47	22, 31
Air defense command:		
Command and control	16, 43	7, 27
General	9, 16, 42*a*	4, 7, 24
Joint training, responsibility for	43*f*	31
Air defense control center	42*a*	24
Air defense direction center	42	24
Air division (defense)	42*a*, 43*c*	24, 29
Air defense plan:		
Combat zone	38	22
Communications zone	39	23
Continental United States	36	21
Objective	40	24
Theater of operations	44, 37	31, 22
Air force:		
Air defense command	18*o*, 42*a*	10, 24
Relationship to AAA	56	40
Tactical air. (*See* Tactical air.)		
Commander	38	22
Air guards	126*e*, 137*a*	129, 139
Air-to-surface missiles	78	77
Allocation of means. (*See* means.)		
Amphibious operations	136*a*	136
Analyzer, light AAA	App. II, 93	152, 96
Antimechanized defense	131	134
Armored division AAA	37	22
Army AA command:		
Missions	9	4
Subordinate headquarters	9	4
Agreements	36	21
Logistics	43*e*	31
Administration	43*e*	31
Organization	42*b*	25
AAAIS	51	36

	Paragraphs	Page
Army AA commander:		
Control	51	36
Duties	16, 36	7, 21
General	15, 51	7, 36
Responsibility, command	43	27
Tactical location AAA	43*d*	31
Army commander	15, 17*e*, 38	7, 9, 22
Artillery commanders:		
General	15	7
Army	18*n*, 48	11, 33
Duties:		
Army AA commander	16, 36	7, 21
Battalion commander, AAA	21	12
Battalion group commander, AAA.	20, 146, 150	12, 147, 148
Brigade commander, AAA	18, 19, 118, 146, 150	9, 11, 121, 147, 148
Corps	15, 49, 50	7, 34, 36
Defense commander, AAA	22, 80, 106, 82*b*, 103*b* 77, 113–115, 122, 123	12, 79, 113, 80, 112, 72, 119, 123, 124
Division artillery commander	15, 47, 48	7, 33
Eastern, Central, Western	17	9
Group commander, AAA	19, 111, 146, 151	11, 117, 147, 149
Army Group, tactical air	52	37
Assailability	App. II, 32*b*	152, 19
Attack, enemy:		
Atomic	64, 73	47, 62
Canalized	74, 78, 131	63, 77, 134
Forced routes of approach	101	110
Installation, nature of	102	111
Routes of approach	58*e*, 64, 100, 101	44, 47, 109, 110
Special conditions of	74, 99	63, 109
Terrain influence on	57*d*	42
Attrition rates	App. II, 58*b*, 59	152, 43, 45
Augmenting fire	130	133

	Paragraphs	Page
Battalion, AAA:		
Battalion commander	21	12
General	13	5
Operations center	111	117
Operations detachment	118	121
Supply	143	144
Battalion, group AAA:		
General	12	5
Operations center	111	117
Operations detachment	118	121
Supply	143	144
Battalion group Commander, AAA	12, 20, 146, 150	5, 12, 147, 148
Battle headquarters	111*a*, 92	117, 95
Bomb release line	App. II, 89, 63, 78*a*, 75	152, 94, 47, 77, 64
Brigade, AAA:		
General	10	5
Operations center	111	117
Operations detachment	118	121
Reconnaissance	150	148
Supply	143	144
Brigade commander, AAA	18, 19, 118, 146, 150	9, 11, 121, 147, 148
Caliber and weight	7	3
Canalized attack:		
Heavy, medium, AA	74	63
Guided missiles	78*c*	78
Antimechanized attack	131	134
Capabilities:		
Antiaircraft matériel	57*b*, 78*b*, 89	41, 78, 94
Enemy	57*a*, 60, 88	41, 46, 93
Central Air Defense Force:		
General	42*a*	24
Commander	17, 43*b*	9, 29
Control	43*b*	29
Organization	42*b*	25

	Paragraphs	Page
Central Army AA command:		
Duties	17	9
Organization	9, 42*b*	4, 25
Chief, Army field forces	16	7
Chief of Staff:		
Air Force, U. S.	43, 36	27, 21
Army, U. S.	16*c*, 43	8, 27
Classification system:		
General	App. II, 6	152, 3
Caliber and weight	7	3
Transport:		
Airborne	App. II, 8*c*	152, 4
Self-propelled	App. II, 8*b*	152, 4
Towed	App. II, 8*a*	152, 4
Combat zone:		
Air defense	38, 46, 48, 49–51	22, 32, 33, 34
Command, control, coordination	48	33
Employment AAA	61	46
General	37	22
Priorities and allocation of means	58	43
Supply	144*d*	145
Command, AAA	16*e*, 49, 50	8, 34, 36
Command, control, coordination:		
Combat zone, general	48	33
Army area	51	36
Corps area	50	36
Division area	49	34
Command duties. (*See* Artillery commanders.)		
Command net	139*a*	139
Committee, air defense	37	22
Communication:		
General	137	138
Discipline	140*d*	142
Establishment of	138*c*	139
Extent of	140	141
Facilities	140*a*	141
Means of	140	141

	Paragraphs	Page
Communication—Continued		
Movement, frequency of	140*b*	141
Nets	139	139
Officer	138	139
Operations center	105*b*	113
Radio	142	143
Requirements	139	139
Responsibility for	138*a*	139
Tactical control	138*b*	139
Technical control	138*b*	139
Wire	141	142
Communications zone:		
Air defense of	45	32
Priorities and allocation of resources.	39	23
Supply	144*c*	145
Composite defense	App. II, 77, 103	152, 72, 111
Conditions of employment, special	133, 135, 138	135, 136, 139
Continental United States:		
Defense plan	36	21
Reconnaissance	152	149
Supply	144*b*	145
Contingent sector of fire	89, 106	94, 113
Coordinated defenses	App. II, 104	152, 112
Corps:		
Commander	15	7
Operation control, AAA	50	36
Criticality	App. II, 32*e*	152, 19
Dead areas of fire units	58*c*, 96	43, 102
Defense. (*See* Air defense.):		
Active means of	30*a*(2)	18
Air. (*See* Air defense.)		
Analysis:		
Effectiveness clock	App. II, 68*b*, 75*c*, 94*b*	152, 51, 67, 100
Recording form	68*a*, 94*a*	51, 96

	Paragraphs	Page
Defense—Continued		
Analyzer	93	96
Balanced	58*a*	43
Composite	App. II, 77, 103	152, 72, 111
Coordinated	App. II, 88, 104	152, 93, 112
Heavy and Medium AAA:		
Attack	64, 74	47, 63
Attrition rate	58*b*, 59	43, 45
Bomb release line	App. II, 63, 75, 78*a*, 89	152, 47, 64, 77, 94
Design	65–68, 69, 70	48, 55
Enemy capabilities	57*a*, 60	41, 46
Fire direction	80–82	79
Flexibility of	62	47
General	59	45
Special considerations	73–79	62
Terrain difficulties	57*d*, 71, 72, 140*c*	42, 58, 142
Vulnerable area	61, 75, 76	46, 64, 67
Integrated	App. II, 104, 105*a*	152, 112, 113
Light AAA:		
Disposition of fire units	90	95
Enemy capabilities	88	93
Factors effecting mission	57, 88	41, 93
Fire direction. (*See* Fire direction.)		
General	86	92
Special considerations	99–105	109
Terrain difficulties	97, 98	105
Tools for analysis	91–94	95
Vulnerable area	95, 96	101, 102
Weapons, capabilities and limitations.	89	94
Defense commander, AAA	22, 113–115	12, 119
Defense command, AA	14	6
Department of the Air Force	36	21

	Paragraphs	Page
Department of the Army	36	21
Department of defense	43*f*	31
Desert operations	136*c*	137
Determination of mission	5*a*	2
Disposition of fire units	58, 90	43, 95
Division artillery commander	15, 47	7, 33
Division commander, duties	15, 47, 49	7, 33, 34
Eastern Air Defense Force:		
Commander	17, 43*b*	9, 29
General	42	24
Eastern Army AA Command	9, 17, 42*b*	4, 9, 25
Effectiveness clock	App. II, 94*b*, 68*b*, 75*c*	152, 100, 51, 67
Emplacement for mission	5*b*	2
Employment, special conditions of	134, 135, 136	136
Enemy:		
Attack. (*See* Attack.)		
Capabilities	57*a*, 60, 88	41, 46, 93
Engagement of	58*c*	43
Tactics	57*a*	41
Engagement of targets. (*See* Targets.)		
Evacuation	144	144
Executive officer	24	13
Factors in air defense	57	41
Field artillery, AAA:		
Mission	129	132
Communications	141*d*	143
Fighters, employment	33	19
Fire direction:		
Field artillery	129, 141*d*	132, 143
Heavy, medium AAA:		
General	80	79
Multiple targets	81	79
Selecting targets	82	79
Light AAA:		
Selecting targets	108	114
Sectors of fire	106	113
Targets	107	114

	Paragraphs	Page
Fire unit analyzers	App. II, 59, 67	152, 45, 48
Fire units:		
Dead areas	58c, 96	43, 102
Disposition	58, 90	43, 95
Flexibility	41, 62	24, 47
Floating fire units	73b	63
Ground control interceptor stations	42a	24
Group, AAA	11, 151	5, 149
Group commander, AAA	19, 111, 146, 151	11, 117, 147, 149
Gun defended area	App. II	152
Heavy AAA:		
Caliber and weight	App. II, 7c	152, 3
Capabilities and limitations	128b	131
Defenses. (*See* Defense.)		
Incidental Protection:		
General	83	80
Special considerations	85	90
Steps in analysis	84	81
Infantry division AAA	47	33
Information service AAA:		
General	18g, 25, 26f, 50, 109, 121	10, 13, 16, 36, 116, 122
Command of	122	123
Control of	123	124
Definition	App. II	152
Facilities	124, 125, 126	124, 125, 126
Mission	121	122
Relationship to AAOC	110	116
Inner artillery zone	App. II	152
Integrated defenses	App. II, 104, 105a	152, 112, 113
Integration, other weapons	88, 105a	93, 113
Intelligence	18c, 60, 88, 111, 112a	10, 46, 93, 117, 118

	Paragraphs	Page
Intelligence net	137*a*, 139*b*	138, 140
Intelligence officer	25	18
Jamming devices	30*b*	18
Joint air defense training	43*f*	31
Joint Chiefs of Staff:		
Allocation of means	28, 35	17, 20
Determination of priorities	35	20
Jungle operations	136*d*	137
Liaison net	139*f*	141
Light AAA:		
Analyzer	App. II, 93	152, 96
Caliber and weight	App. II, 7*a*	152, 3
Capabilities and limitations	128*c*	131
Defenses. (*See* Defense.)		
Division	47	33
Logistics	43*e*	31
Means, allocation:		
Criteria for AAA	34	20
General considerations	31, 33	18, 19
Joint Chiefs of Staff	28, 35	17, 20
Responsibility for:		
Combat zone	38	22
Communication zone	39	23
Continental United States	36	21
Theater of operations	37	22
Means of defense. (*See* Defense.)		
Medium AAA:		
Caliber and weight	App. II, 7*b*	152, 3
Capabilities and limitations	128*b*	131
Mission:		
Air defense	4	2
Capabilities and limitations	78*b*, 89	78, 94
Determination of	5*a*	2
Dual	4	2
Emplacement	5*b*	2
Factors effecting	57, 87	41, 93
Field artillery	129	132

	Paragraphs	Page
Mission—Continued		
Fire units, disposition	58, 90	43, 95
Information	121	122
Operations detachment	118*a*	121
Reconnaissance	146–152	147
Surface. (*See* Surface mission.)		
Mountain operations	136*c*	137
Multiple vulnerable areas	76, 126*b*	67, 127
Naval commander	38	22
Navy defense	16*g*, 17*d*	9
Navy, floating fire units	73*b*	63
Noncircular vulnerable area	75	64
Objective, plan	40	24
Observation posts	124*b*, 126, 139*c*	124, 126, 140
Operational control net	139*c*	140
Operations center:		
Alternate	114	120
AAAIS, relationship to	110	116
Command of	113	119
Defense commander	113–115, 122, 123	119, 123, 124
Defined	111*a*	117
Equipment	119	122
Functions	112	118
General	18*b*, 49, 56, 105*b*, 109, 111	10, 34, 40, 113, 116, 117
Information	116	120
Location of	117	120
Organization	111*b*	118
Operation	120	122
Personnel	119	122
Relationship to AAAIS	110	116
Subordinate	115	120
Operations detachment:		
Attachment	118*b*	121
Mission	118*a*	121
Personnel and equipment	118*c*	121

	Paragraphs	Page
Operations, special:		
Airborne	136*e*	137
Amphibious	136*a*	136
Desert	136*b*	136
Jungle	136*d*	137
Mountain	136*c*	137
Winter	136*f*	137
Optimum gun ring	App. II	152
Optimum gun sight	70*a*, 75	55, 64
Organization. (*See* Air defense.)		
Plan. (*See* Air defense plan.)		
Planning factors table:		
Light AAA	App. II, 72, 76, 78, 79, 86, 92, 96, 98*c*	152, 58, 67, 77, 78, 92, 95, 102, 105
Heavy and medium AAA	App. II, 59, 66, 76*b*	152, 45, 48, 70
Position. (*See* Reconnaissance.)		
Priorities for air defense:		
Assailability	32	19
Criteria	32	19
Criticality	App. II, 32*e*	152, 19
Joint Chiefs of Staff	35	20
Recuperability	App. II, 32*d*	152, 19
Responsibility for determination	36–39, 49	21, 34
Selection	32*a*	19
Vulnerability	32*c*	19
Radar:		
Coordination	125*c*	126
Employment of	125*a*, *b*	125
Officer	26, 125*b*	13, 125
Reporting net	139*d*	140
Surface mission employment	133	135
Surveillance	124*a*	124
Reconnaissance, selection position:		
Brigade	150	148
Duties of commanders	148	148

	Paragraphs	Page
Reconnaissance, selection position —Continued		
General	58, 146, 152	43, 147, 149
Group	151	149
Nature of	146, 147	147
Static situations	152	149
Time available	149	148
Recording form	68*a*, 94*a*	51, 96
Recuperability of installation	32*d*	19
Restricted area	App. II	152
Resources, allocation of	29	17
Routes of enemy approach	58*e*, 64, 100, 101	44, 47, 109, 110
Sectors of fire	106	113
Selection of position. (*See* Reconnaissance.)		
Selection of vital areas	32*a*	19
Self-propelled AAA	App. II, 8*b*	152, 4
Signal corps agencies	137*b*, 140*a*	138, 141
Staff, AAA:		
Duties:		
Executive officer	24	13
Intelligence officer	25	13
Other staff officers	27	16
Radar officer	26, 125*b*	13, 125
General	23	12
Supply:		
Continental United States	144*b*	145
Economy	145	146
Evacuation procedure	144	144
General	143	144
Surface mission:		
Employment of AAA:		
Antimechanized defense	131	134
Augmenting fire	130	133
Capabilities, limitations	128	130
Field artillery	129	132
General	127	130

	Paragraphs	Page
Surface mission—Continued		
Employment of AAA—Continued		
Radar	133	135
Special conditions of	134–136	136
General	4	2
Surface-to-air missiles	48	33
Surface-to-surface missiles	48, 78	33, 77
Surveillance radar	124*a*	124
Tactics	135	136
Tactical air:		
Army group	52	37
Command	52	37
Control party	55*b*	38
Control system	54	37
Direction center	55*b*(2)	39
Direction post	55*b*(4)	39
Force	53	37
Operations system	54	37
Relation to AAA	56	40
Tactical headquarters, AAOC is	111*a*	117
Tactical missions in close support	129*b*	132
Targets:		
Air-to-surface missiles	78	77
Capabilities	78*b*	78
Engagement of:		
Multiple targets	58*d*, 81, 107*b*, 108	44, 79, 114
One target	107*a*	114
Fire direction	80	79
Selection of	82*b*, 106, 108	80, 113, 114
Surface-to-surface missiles	48, 78	33, 77
Waterborne	132	134
Terrain:		
Communications	140*c*	142
General	57*d*	42
Heavy, medium AAA:		
Composite defense	77	72
Major difficulties	71, 72	58

	Paragraphs	Page
Terrain—Continued		
Light AAA:		
Major difficulties	97, 98	105
Theater commander:		
Air defense plan	37	22
Air defense priorities	37	22
Air defense, responsibility for	44	31
Tactical air	52	37
Theater of operations:		
Air defense	37, 44–47	22, 31
Priorities and allocation of means.	37	22
Supply	144c	145
Towed AAA	App. II, 8a	152, 4
Transport	8	4
United States defense plan	36	21
Vital area	App. II	152
Vulnerability of installation	App. II, 32c	152, 19
Vulnerable area:		
Atomic attack	64, 73	47, 62
Control and coordination	126b(2)	127
General	App. II, 30b	152, 18
Heavy and medium AAA defense of.	61, 75, 76	46, 64, 67
Light AAA defense of	95, 96	101, 102
Location of	61	46
Multiple	76, 126b	67, 127
Nature of	57c	42
Noncircular	75	64
Planning defense of	96	102
Plotting	70a	55
Vulnerable point	App. II	152
Warning agency, information service	121	122
Water areas	73b	63
Waterborne targets	132	134

	Paragraphs	Page
Weapons:		
Capabilities, limitations [redacted]	b, 78b, 89, 128	4, 41, 78, 94, 130
Classification	6–8	3
Weather	57d	42
Western Army AA Command	9, 17, 42b	4, 9, 25
Western Air Defense Commander	17, 43b	9, 29
Western Air Defense Force:		
Control	43b	29
General	42a	24
Organization	42b	25
Wind	79	78
Winter (arctic) operations	136f	137

☆ U. S GOVERNMENT PRINTING OFFICE: 1952—951138